Solar Inverter

Clearline
INVERTER

3.0 to 6.0kW
Dual String Single Phase

Suitable for solar installations from 2.4kWp up to 9.0kWp (DC)

- **Discreet and Lightweight** - Compact and stylish with whisper quiet operation.
- **Enhanced Generation** - low start-up voltage generates power in low light conditions.
- **Smart Control.** Generation monitoring and optional export limitation.
- **Safe and Reliable.** Factory fitted DC isolator switch for improved safety.
- **10 Year Warranty.**
- **UK Technical and Design Support.**

Viridian Solar, Atlas Building, 68 Stirling Way,
Papworth, Cambridge CB23 3GY

01480 839 865
www.viridiansolar.com

80046 Version 1.2

viridian solar

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Specification

		CSI3000D	CSI3600D	CSI5000D	CSI6000D
OUTPUT					
Nominal Output Power	W	3,000	3,600	5,000	6,000
Nominal Output Apparent Power	VA	3,000	3,600	5,000	6,000
Max. AC Active Power	W	3,300	3,600	5,500	6,600
Max. AC Apparent Power	VA	3,300	3,600	5,500	6,600
Nominal Output Voltage	V	220/230/240	220/230/240	220/230/240	220/230/240
Nominal AC Grid Frequency	Hz	50/60	50/60	50/60	50/60
Max. Output Current	A	14.4	16.0	24.0	28.8
Power Factor		~1 (adjustable from 0.8 leading to 0.8 lagging)			
Max. Total Harmonic Distortion		<3%	<3%	<3%	<3%
INPUT					
Max. Input Power	W	4,500	5,400	7,500	9,000
Max. Input Voltage	V	600	600	600	600
MPPT Operating Voltage Range	V	40~560	40~560	40~560	40~560
Start-up Voltage	V	50	50	50	50
Nominal Input Voltage	V	360	360	360	360
Max. Input Current per MPPT	A	16	16	16	16
Max. Short Circuit Current per MPPT	A	23	23	23	23
Number of MPPT Trackers		2	2	2	2
Number of Strings per MPPT		1	1	1	1
EFFICIENCY					
Max. Efficiency		97.9%	97.9%	97.9%	97.9%
European Efficiency		97.0%	97.0%	97.3%	97.4%

GENERAL		
Operating Temperature Range	°C	-25 to +60
Relative Humidity		0 to 100%
Max. Operating Altitude	m	4,000
Cooling Method		Natural Convection
User Interface		LED, LCD, WLAN and App
Communication		WiFi or LAN
Weight	kg	12.8, 13.4 (CSI6000)
Dimensions (WxHxD)	mm	350 x 410 x 143
Noise Emission	dB	<25
Topology		Non-isolated
Standby Power Consumption	W	<1
Ingress Protection (IP) Rating		IP66
DC Connector		MC4 (4-6 mm^2)
AC Connector		plug and play connector (max 6mm^2)

PROTECTION	
PV Insulation Resistance Detection	Integrated
Residual Current Monitoring	Integrated
Anti-Islanding Protection	Integrated
AC Overcurrent Protection	Integrated
AC Short Circuit Protection	Integrated
AC Overvoltage Protection	Integrated
DC Switch	Integrated
DC Surge Protection	Type III (Type II Optional)
AC Surge Protection	Type III (Type II Optional)
AFCI	Option
Emergency Power Off	Option
Remote Shutdown	Option

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viridian solar

Clearline Inverter - Limited Guarantee

Viridian Solar Ltd., (hereinafter “Viridian”) shall provide to any purchaser (“Purchaser”) of its Clearline Inverter and associated Accessories (“Products”), limited guarantees as to the quality and/or performance of its Products in accordance with the following terms and conditions.

1.0 General Conditions

The guarantees will start from the date of installation of the relevant Product and is transferrable to subsequent owners of the location to which the Product is installed. Where the installation date cannot be confirmed, the start date will be taken as one month after the shipment of the product from Viridian. The execution of the guarantees will not lead to any prolongation of the original guarantee period. The guarantees apply to products delivered after 1st January 2023. The Purchaser’s statutory rights under applicable national legislation are not affected by the guarantees.

The guarantees are conditional upon the Products being properly handled and installed by competent persons who have correctly followed the installation instructions applicable at that time and have used best-practice methods for their respective trades. It is also contingent on the Products being used in the manner that Viridian intended. The guarantees are also dependant on the proper use and maintenance of the Products according to Viridian’s instructions. It is the responsibility of the Purchaser to demonstrate, to the reasonable satisfaction of Viridian, that the exclusions in this section 1.0 and section 3.0 of this document do not apply in respect of any claim under the guarantees.

The guarantees may not be claimed against unless and until the relevant Product has been paid for in full. Any claim under the guarantees shall be promptly notified in writing by the Purchaser as set out in section 4.0 below.

Viridian does not accept liability (whether in tort [including for negligence or breach of statutory duty], contract, misrepresentation or otherwise) for any loss of profits; loss of business; depletion of goodwill or similar losses; loss of anticipated savings; loss of goods; loss of use; or any special, indirect or consequential losses arising from the failure of the Products howsoever caused.

This exclusion of liability does not affect, or attempt to affect, any of the Purchaser’s rights under applicable national legislation.

The guarantees do not cover costs associated with installation, removal, or reinstallation of the Products.

In no event will Viridian’s aggregate liability under the guarantees exceed the original value of the Products which are the subject of a claim or dispute.

Any exchanged or replaced components or Products shall pass into the ownership of Viridian.

The Purchaser accepts that the Products were not designed and produced to its individual requirements and that the Purchaser was responsible for their selection.

2.0 Product Guarantee

For the purposes of this Product Guarantee, a “Defect” means behaviour of the relevant Product which does not meet the relevant specification set out in the technical data sheet (available at www.viridiansolar.com) and which is caused by failings in the materials or workmanship used or deployed in the production of the relevant Product. For the avoidance of doubt, a Defect does not occur when the Product does not meet a particular need but does meet a reasonable interpretation of the behaviour defined in the technical datasheet.

Viridian guarantees in respect of each Product that, for the periods set out in respect of each Product type below, the relevant Product will not be subject to a Defect.

Product	Product Code Starting	Years
Clearline Inverter	CSI	10
Inverter WiFi Module	CSI-WIFI	2

The Purchaser shall promptly notify Viridian of any breach of the above Product Guarantee in accordance with section 4.0.

In the event of a claim being approved, the Purchaser's sole remedy for breach of this Product Guarantee and Viridian's sole obligation shall be that Viridian will, at its sole option, reimburse the Purchaser for the original purchase, repair the Product, or supply a replacement new or refurbished Product. If the type of Product which is subject to the claim is no longer available, a Product of equivalent performance (as judged by Viridian), may be supplied.

The Purchaser shall provide all information as may be deemed necessary by Viridian to assist Viridian in remedying any Defect.

The period of Product Guarantees for any replacement Products supplied pursuant to this Product Guarantee will be equal to the remainder of the guarantee period of the originally supplied Product.

3.0 Exclusions

No claim may be brought after expiry of the applicable guarantee periods.

This Product Guarantee is subject to the following conditions:

- The Product being properly handled and installed by competent persons who have correctly followed the installation instructions applicable at that time and have used best-practice methods for their respective trades.
- The Product is used only on the electricity supply printed on the rating plate.
- The Product is used in the United Kingdom or Republic of Ireland.
- The Product has been used in accordance with the User Guide.
- The serial number of the Product, components or accessories have not been altered, cancelled, or removed.
- The Product has not been altered, serviced, maintained, dismantled or otherwise interfered with by any person not authorised by Viridian. For the avoidance of doubt any attempt to open the unit by anyone other than us or our appointed agent will invalidate the warranty.
- Any repair work must be undertaken by us or our appointed agent having first been agreed with Viridian Technical Support.
- That any return of the Product is done as specified in the Return Materials Authorisation ("RMA") instructions provided by Viridian.

The Guarantee does not cover defects which in Viridian's judgement have been caused by:

- Fair wear and tear (e.g., colour fading, scratches on top cover/machine body).
- Installation that is not in conformance with product specifications, installation instructions, operation manuals, labelling or prevailing standards and regulations
- Any damage due to miswiring, and/or software/hardware misconfiguration
- Failure to demonstrate that recommended maintenance procedures have been followed.
- Defective transportation, storage, or handling

- Usage which does not comply with the safety regulations (VDE, IEC, etc.).
- Operation outside the specified operating temperature and or humidity range
- Use of incompatible spare parts or accessories not supplied or approved by Viridian.
- Unauthorised modification of the Product, including the addition of marks and stickers
- Breakage due to external influences – power surge, flying objects, external loads, vandalism or theft.
- Damage due to shock/vibration.
- Damage due to improper IP protection (dust/fluid ingress)
- Damage caused by external factors – such as dirt, soiling, smoke, chemicals, pollution.
- Damage by natural disasters (such as fires, earthquakes, cyclones, hurricanes, volcano eruptions, lightning, indirect lightning strikes, heavy snow falls, avalanches, frost damage) or other unforeseeable circumstances.
- Relocation from the original place of installation
- Faults caused by interaction with equipment not supplied or approved in writing by Viridian
- Third party software or from virus(es).

The warranty does not cover:

- Product failure not reported to Viridian within one month of appearance.
- Damage resulting from transportation, improper use, wear and tear, neglect or interference or as a result of improper installation.
- Replacement of any consumable item or accessory not supplied by us.
- Any rust that appears on the device's enclosure caused by harsh environmental conditions. Faults or damage caused by exposure to coastal environments/saltwater or other aggressive atmospheres or environmental conditions without Viridian's written confirmation/approval prior to the installation.

Viridian is not responsible for:

- Software loss or data loss that may occur during the repair or replacement of the product.
- Damage to or loss of any program, data, or removable storage media, or for costs of recovering any program or data.
- Confidential, proprietary, or personal information contained in the product which you return to us for any reason.
- Costs associated with de-installation or re-installation of any product.

4.0 Claims Procedure

Claims should be addressed to

warranty@viridiansolar.co.uk

or
Viridian Solar
Atlas Building
68 Stirling Way
Papworth
Cambridge, UK
CB23 3GY

The email must contain the following information regarding the device and the nature of the malfunction:

1. The serial number of the Product.
2. Proof of purchase.
3. Photographs of the Product in current state.
3. Installation information, including brand, model, and number of PV panels; if the defective product is an energy storage system, the brand and model of batteries are also needed.
4. Date of installation, date of malfunction.
5. Detailed description of the malfunction including any error messages on the LCD screen and any actions taken before the claim.

Without this information, your claim cannot be processed.

Viridian will endeavour to respond to the claim within 5 working days and resolve the claim within 28 days.

If we determine that the malfunction is potentially due to causes under warranty, then we will issue a Returns Merchandise Authorisation (RMA) to ship back the unit.

The returns process is as outlined below:

- Once received, Viridian will analyse the device that was returned under the RMA.
- If Viridian determines that the malfunction is due to the causes under warranty, the Product is repaired or replaced and shipped back to the customer (at our expense).
- If Viridian determines that the malfunction is not due to the causes under warranty, the warranty claim is rejected, and the Product is shipped back to the customer (at customer's expense).

When preparing your Product for shipment to Viridian, we recommend the following:

- The Product is returned in its original packaging. The original packaging will provide better protection for the Product during transit. The warranty may be voided if the Product is damaged due to improper packaging.
- Please do not send in anything but the Product itself unless specially requested by us. Any other items and accessories included in the package received by us will be treated as packaging material and may not be returned.
- Please note: if your Product is received packed in anything other than its original packaging, we may invoice you for appropriate anti-shock packaging when your Product is returned.

Form C: Type Test Verification Report

All Micro-generators connected to the **DNO Distribution Network** shall be **Fully Type Tested**. This form is the **Manufacturer**'s declaration of compliance with the requirements of EREC G98.

This form should be used when making a Type Test submission to the Energy Networks Association (ENA)Type TestRegister.

If the **Micro-generator** is **FullyType Tested** and already registered with the ENA Type TestRegister, the **Installation Document** should include the **Manufacturer**'s Reference Number (the system reference), and this form does not need to be submitted.

Manufacturer's reference number	Clearline Inverter CSI3000D		
Micro-generator technology	Grid-Connected PV Inverter		
Manufacturer name	Viridian Solar Ltd		
Address	68 Stirling Way, Papworth Everard, Cambridge, CB23 3GY United Kingdom		
Tel	+44 (0)1480 839 865	Fax	/
E-mail	info@viridiansolar.co.uk	Web site	www.viridiansolar.co.uk

Registered Capacity, use separate sheet if more than one connection option.	Connection Option	
	3.0	kW single phase, single, split or three phase system
	/	kW three phase
	/	kW two phases in three phase system
	/	kW two phases split phase system
Energy storage capacity for **Electricity Storage** devices		Not energy storage inverter

ManufacturerType Test declaration. - I certify that all products supplied by the company with the above **Fully Type Tested** reference number will be manufactured and tested to ensure that they perform as stated in this document, prior to shipment to site and that no site modifications are required to ensure that the product meets all the requirements of EREC G98.

Note that testing can be done by the **Manufacturer** of an individual component or by an external test house.

Where parts of the testing are carried out by persons or organisations other than the **Manufacturer** then that person or organisation shall keep copies of all test records and results supplied to them to verify that the testing has been carried out by people with sufficient technical competency to carry out the tests.

1.**Operating Range:** This test should be carried out as specified in A.1.2.10.

Pass or failure of the test should be indicated in the fields below (right hand side), for example with the statement "Pass", "No disconnection occurs", etc. Graphical evidence is preferred.

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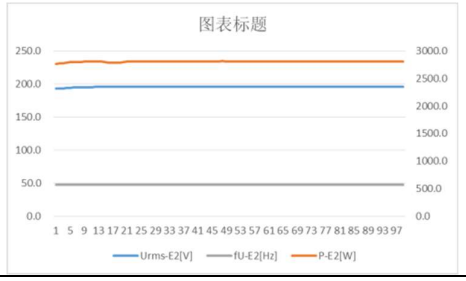
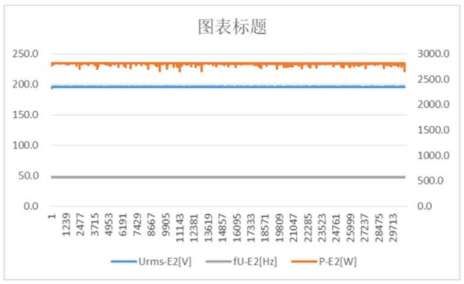
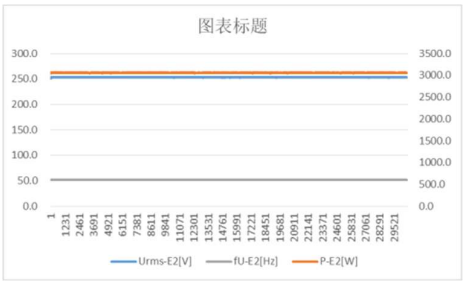
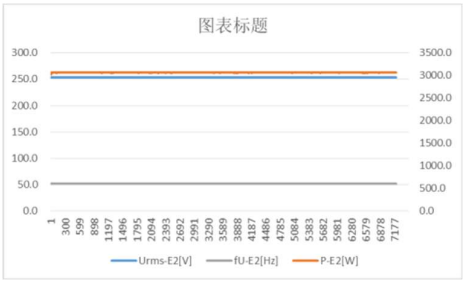
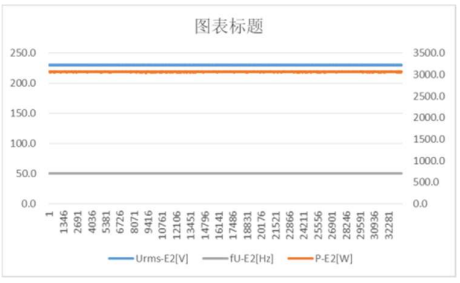
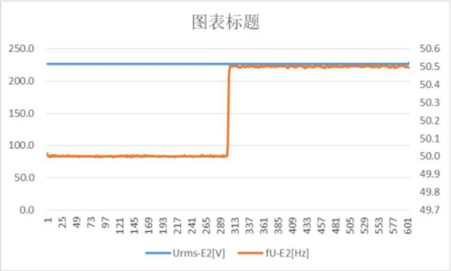
Test 1 Voltage = 85% of nominal (195.5 V) Frequency = 47.0 Hz Power factor = 1 Period of test 20 seconds	Result:Pass 
Test 2 Voltage = 85% of nominal (195.5 V) Frequency = 47.5 Hz Power factor = 1 Period of test 90 minutes	Result:Pass 
Test 3 Voltage = 110% of nominal (253 V). Frequency = 51.5 Hz Power factor = 1 Period of test 90 minutes	Result:Pass 
Test 4 Voltage = 110% of nominal (253 V). Frequency = 52.0 Hz Power factor = 1 Period of test 15 minutes	Result:Pass 
Test 5 Voltage = 100% of nominal (230 V). Frequency = 50.0 Hz Power factor = 1 Period of test 90 minutes	Result:Pass 

Test 6 RoCoF withstand Confirm that the **Micro-Generating Plant** is capable of staying connected to the **Distribution Network** and operate at rates of change of frequency up to 1 Hzs^{-1} as measured over a period of 500 ms.	Result:Pass 

2. Power Quality – Harmonics: These tests should be carried out as specified in BS EN 61000-3-2. The chosen test should be undertaken with a fixed source of energy at two power levels a) between 45 and 55% and b) at 100% of **Registered Capacity**. The test requirements are specified in Annex A1 A.1.3.1 (**Inverter** connected) or Annex A2 A.2.3.1 (Synchronous).

Micro-generator tested to BS EN 61000-3-2			
Micro-generator rating per phase (rpp)	3.0	kW	
For 3-phase **Micro-generator**s, tick this box if harmonic measurements are identical for all three phases. If the harmonics are not identical for each phase, please replicate this section with the results for each phase.			

Harmonic	At 45-55% of **Registered Capacity**[1]		100% of **Registered Capacity**			
	Measured Value MV in Amps		Measured Value MV in Amps		Limit in BS EN 61000-3-2 in Amps	Higher limit for odd harmonics 21 and above
2	0.022		0.030		1.080	
3	0.019		0.029		2.300	
4	0.008		0.013		0.430	
5	0.010		0.009		1.140	
6	0.007		0.007		0.300	
7	0.015		0.017		0.770	
8	0.006		0.007		0.230	
9	0.021		0.026		0.400	
10	0.006		0.006		0.184	
11	0.057		0.083		0.330	
12	0.005		0.005		0.153	
13	0.041		0.070		0.210	
14	0.005		0.005		0.131	
15	0.028		0.058		0.150	
16	0.005		0.005		0.115	

[1] See the note in A.2.3.1 if 45-55% of **Registered Capacity**is below the minimum stable operating level. If an alternative loading level is chosen, the level should be indicated on the test form and the reason for not testing at 45-55% of **Registered Capacity**should be stated. The additional comments box at the end of the harmonics test sheet can be used for this.

17	0.019		0.048		0.132	
18	0.005		0.005		0.102	
19	0.013		0.040		0.118	
20	0.005		0.005		0.092	
21	0.008		0.033		0.107	0.160
22	0.005		0.005		0.084	
23	0.006		0.028		0.098	0.147
24	0.005		0.005		0.077	
25	0.005		0.023		0.090	0.135
26	0.005		0.005		0.071	
27	0.005		0.020		0.083	0.124
28	0.005		0.005		0.066	
29	0.005		0.017		0.078	0.117
30	0.004		0.005		0.061	
31	0.005		0.014		0.073	0.109
32	0.005		0.004		0.058	
33	0.005		0.013		0.068	0.102
34	0.005		0.005		0.054	
35	0.004		0.011		0.064	0.096
36	0.006		0.005		0.051	
37	0.004		0.010		0.061	0.091
38	0.006		0.005		0.048	
39	0.004		0.009		0.058	0.087
40	0.006		0.006		0.046	

Note the higher limits for odd harmonics 21 and above are only allowable under certain conditions, if these higher limits are utilised please state the exemption used as detailed in part 6.2.3.4 of BS EN 61000-3-2 in the box below.

Additional comments:

3. **Power Quality – Voltage fluctuations and Flicker**: These tests should be undertaken in accordance with EREC G98 Annex A1 A.1.3.3 (**Inverter** connected) or Annex A2 A.2.3.3 (Synchronous).

The standard test impedance is 0.4 Ω for a single phase **Micro-generating Plant** (and for a two phase unit in a three phase system) and 0.24 Ω for a three phase **Micro-generating Plant** (and for a two phase unit in a split phase system). Please ensure that both test and standard impedance are completed on this form. If the test impedance (or the measured impedance) is different to the standard impedance, it must be normalised to the standard impedance as follows (where the **Power Factor** of the generation output is 0.98 or above):

d maxnormalised value = (Standard impedance / Measured impedance) x Measured value.

Where the **Power Factor** of the output is under 0.98 then the X to R ratio of the test impedance should be close to that of the standard impedance.

The stopping test should be a trip from full load operation.

The duration of these tests needs to comply with the particular requirements set out in the testing notes for the technology under test.

The test date and location must be declared.

Test start date	2024.8.21	Test end date	2024.8.29
Test location	test lab of GoodWe Technologies Co., Ltd (No.90 Zijin Rd., New District, Suzhou, 215011, China)		

	Starting			Stopping			Running	
	d(max)	d(c)	d(t)	d(max)	d(c)	d(t)	P_{st}	P_{lt} 2 hours
Measured Values at test impedance	0.189 %	0.086 %	0.0%	0.187%	0.074%	0.0%	0.120	0.122
Normalised to standard impedance	0.189 %	0.086 %	0.0%	0.187%	0.074%	0.0%	0.120	0.122
Normalised to required maximum impedance	NA	NA	NA	NA	NA	NA	NA	NA
Limits set under BS EN 61000-3-11	4%	3.3%	3.3%	4%	3.3%	3.3%	1.0	0.65

Test Impedance	R	0.4	Ω	X	0.25	Ω
Standard Impedance	R	0.24 * 0.4 ^	Ω	X	0.15 * 0.25 ^	Ω
Maximum Impedance	R	NA	Ω	X	NA	Ω

*Applies to three phase and split single phase **Micro-generators**. Delete as appropriate.

^ Applies to single phase **Micro-generators** and **Micro-generators** using two phases on a three phase system. Delete as appropriate.

4. **Power quality – DC injection:** This test should be carried out in accordance with A 1.3.4 as applicable.

The % **DC** injection ("as % of rated AC current" below) is calculated as follows:

% **DC** injection = Recorded **DC** value in Amps / base current

where the base current is the **Registered Capacity** (W) / 230 V. The % **DC** injection should not be greater than 0.25%.

Test power level	20%	50%	75%	100%
Recorded **DC** value in Amps	0.0140A	0.0161A	0.0151A	0.0160A
as % of rated AC current	0.107%	0.123%	0.115%	0.123%
Limit	0.25%	0.25%	0.25%	0.25%

5. Power Quality – Power factor: This test shall be carried out in accordance with A.1.3.2 and A.2.3.2 at three voltage levels and at **Registered Capacity** and the measured **Power Factor** must be greater than 0.95 to pass. Voltage to be maintained within ±1.5% of the stated level during the test.

	216.2 V	230 V	253 V
Measured value	0.987	0.988	0.984
Power Factor Limit	>0.95	>0.95	>0.95

6. Protection – Frequency tests: These tests should be carried out in accordance with Annex A1 A.1.2.3 (**Inverter** connected) or Annex A2 A.2.2.3 (Synchronous). For trip tests, frequency and time delay should be stated. For "no trip tests", "no trip" can be stated.

Function	Setting	Trip test	"No trip tests"

	Frequency	Time delay	Frequency	Time delay	Frequency /time	Confirm no trip
U/F stage 1	47.5 Hz	20 s	47.48 Hz	20.06s	47.7 Hz 30 s	no trip
U/F stage 2	47 Hz	0.5 s	46.90 Hz	0.51s	47.2 Hz 19.5 s	no trip
					46.8 Hz 0.45 s	no trip
O/F stage 1	52 Hz	0.5 s	52.02 Hz	0.56s	51.8 Hz 120.0 s	no trip
					52.2 Hz 0.45 s	no trip

Note. For frequency trip tests the frequency required to trip is the setting ± 0.1 Hz. In order to measure the time delay a larger deviation than the minimum required to operate the projection can be used. The "No trip tests" need to be carried out at the setting ± 0.2 Hz and for the relevant times as shown in the table above to ensure that the protection will not trip in error.

7. Protection – Voltage tests: These tests should be carried out in accordance with Annex A1 A.1.2.2 (**Inverter** connected) or Annex A2 A.2.2.2 (Synchronous). For trip tests, voltage and time delay should be stated. For "no trip tests", "no trip" can be stated.

Function	Setting		Trip test		"No trip tests"	
	Voltage	Time delay	Voltage	Time delay	Voltage /time	Confirm no trip
U/V	184 V	2.5 s	183.5V	2.50s	188 V 5.0 s	no trip
					180 V 2.45 s	no trip
O/V stage 1	262.2 V	1.0 s	265.0V	1.01s	258.2 V 5.0 s	no trip
O/V stage 2	273.7 V	0.5 s	277.0V	0.50s	269.7 V 0.95 s	no trip
					277.7 V 0.45 s	no trip

Note for Voltage tests the Voltage required to trip is the setting ±3.45 V. The time delay can be measured at a larger deviation than the minimum required to operate the protection. The No trip tests need to be carried out at the setting ±4 V and for the relevant times as shown in the table above to ensure that the protection will not trip in error.

8. Protection – Loss of Mains test: For PV **Inverter**s shall be tested in accordance with BS EN 62116. Other **Micro-generator**s should be tested in accordance with A.2.2.4 at 10%, 55% and 100% of rated power.

To be carried out at three output power levels with a tolerance of plus or minus 5% in Test Power levels.[2]

[2] See the note in A.2.2.4 if the suggested loading levels are below the minimum stable operating level. If alternative loading levels are chosen, the level should be indicated on the test form and the reason for not testing at 10%/55% of **Registered Capacity** should be stated. The additional comments box at the end of the loss of mains test sheet can be used for this.

Test Power	10%	55%	100%	10%	55%	100%
Balancing load on islanded network	95% of **Registered Capacity**	95% of **Registered Capacity**	95% of **Registered Capacity**	105% of **Registered Capacity**	105% of **Registered Capacity**	105% of **Registered Capacity**
Trip time. Limit is 0.5 s	0.310s	0.412s	0.492s	0.298s	0.430s	0.432s
For Multiphase **Micro-generators** confirm that the device shuts down correctly after the removal of a single fuse as well as operation of all phases.						
Test Power	10%	55%	100%	10%	55%	100%
Balancing load on islanded network	95% of **Registered Capacity**	95% of **Registered Capacity**	95% of **Registered Capacity**	105% of **Registered Capacity**	105% of **Registered Capacity**	105% of **Registered Capacity**
Trip time. Ph1 fuse removed	NA	NA	NA	NA	NA	NA
Test Power	10%	55%	100%	10%	55%	100%
Balancing load on islanded network	95% of **Registered Capacity**	95% of **Registered Capacity**	95% of **Registered Capacity**	105% of **Registered Capacity**	105% of **Registered Capacity**	105% of **Registered Capacity**
Trip time. Ph2 fuse removed	NA	NA	NA	NA	NA	NA
Test Power	10%	55%	100%	10%	55%	100%
Balancing load on islanded network	95% of **Registered Capacity**	95% of **Registered Capacity**	95% of **Registered Capacity**	105% of **Registered Capacity**	105% of **Registered Capacity**	105% of **Registered Capacity**
Trip time. Ph3 fuse removed	NA	NA	NA	NA	NA	NA
Note for technologies which have a substantial shut down time this can be added to the 0.5 s in establishing that the trip occurred in less than 0.5 s. Maximum shut down time could therefore be up to 1.0 s for these technologies.						
Indicate additional shut down time included in above results.				NA ms		
Additional comments:						

For **Inverter**s tested to BS EN 62116 the following sub set of tests should be recorded in the following table.						
Test Power and imbalance	33%	66%	100%	33%	66%	100%

	-5% Q Test 22	-5% Q Test 12	-5% P Test 5	+5% Q Test 31	+5% Q Test 21	+5% P Test 10
Trip time. Limit is 0.5 s[3]	0.309s	0.478s	0.393s	0.260s	0.410s	0.468s

9. Protection – Frequency change, Vector Shift Stability test: This test should be carried out in accordance with EREC G98 Annex A1 A.1.2.6 (**Inverter** connected) or Annex A2 A.2.2.6 (Synchronous). Confirmation is required that the **Micro-generating Plant** does not trip under positive / negative vector shift.

	Start Frequency	Change	Confirm no trip
Positive Vector Shift	49.0 Hz	+50 degrees	no trip
Negative Vector Shift	50.0 Hz	- 50 degrees	no trip

10. Protection – Frequency change, RoCoF Stability test: The requirement is specified in section 11.3, test procedure in Annex A.1.2.6 (**Inverter** connected) or Annex A2 A.2.2.6 (Synchronous). Confirmation is required that the **Micro-generating Plant** does not trip for the duration of the ramp up and ramp down test.

Ramp range	Test frequency ramp:	Test Duration	Confirm no trip
49.0 Hz to 51.0 Hz	+0.95 Hzs^{-1}	2.1 s	no trip
51.0 Hz to 49.0 Hz	-0.95 Hzs^{-1}	2.1 s	no trip

11. Limited Frequency Sensitive Mode – Overfrequency test: This test should be carried out in accordance with A.1.2.8. The test should be carried out using the specific threshold frequency of 50.4 Hz and **Droop** of 10%. The measurement tolerances are contained in A.1.2.8.

Test sequence at **Registered Capacity**>80%	Measured **Active Power** Output	Frequency	Primary Power Source	**Active Power** Gradient Droop(%)
Step a) 50.00 Hz ±0.01 Hz	3077	50	3077	/
Step b) 50.45 Hz ±0.05 Hz	3038	50.45		/
Step c) 50.70 Hz ±0.10 Hz	2873	50.7		9.09%
Step d) 51.15 Hz ±0.05 Hz	2576	51.15		9.33%
Step e) 50.70 Hz ±0.10 Hz	2873	50.7		9.09%
Step f) 50.45 Hz ±0.05 Hz	3038	50.45		/
Step g) 50.00 Hz ±0.01 Hz	3076	50		/

[3] If the device requires additional shut down time (beyond 0.5s but less than 1s) then this should be stated on this form.

Test sequence at **Registered Capacity** 40% - 60%	Measured **Active Power** Output	Frequency	Primary Power Source	Active Power Gradient Droop(%)
Step a) 50.00 Hz ±0.01 Hz	1541	50	1541	/
Step b) 50.45 Hz ±0.05 Hz	1497	50.45		/
Step c) 50.70 Hz ±0.10 Hz	1332	50.7		9.09%
Step d) 51.15 Hz ±0.05 Hz	1034	51.15		9.06%
Step e) 50.70 Hz ±0.10 Hz	1332	50.7		9.09%
Step f) 50.45 Hz ±0.05 Hz	1497	50.45		/
Step g) 50.00 Hz ±0.01 Hz	1541	50		/

12. Power output with falling frequency test: This test should be carried out in accordance with A.1.2.7.

Test sequence	Measured **Active Power** Output	Frequency	Primary power source
Test a) 50 Hz ± 0.01 Hz	3081	50	3081
Test b) Point between 49.5 Hz and 49.6 Hz	3080	49.55	3081
Test c) Point between 47.5 Hz and 47.6 Hz	3080	47.55	3081
NOTE: The operating point in Test (b) and (c) shall be maintained for at least 5 minutes			

13. Re-connection timer.

Test should prove that the reconnection sequence starts after a minimum delay of 20 s for restoration of voltage and frequency to within the stage 1 settings of Table 2. Both the time delay setting and the measured delay should be provided in this form; both should be greater than 20 s to pass. Confirmation should be provided that the **Micro-generating Plant** does not reconnect at the voltage and frequency settings below; a statement of "no reconnection" can be made.

Time delay setting	Measured delay		Checks on no reconnection when voltage or frequency is brought to just outside stage 1 limits of table 2.			
48s	48s		At 266.2 V	At 180.0 V	At 47.4 Hz	At 52.1 Hz
Confirmation that the **Micro-generator** does not re-connect.			No re-connection	no re-connection	no re-connection	no re-connection

14. Fault level contribution: These tests shall be carried out in accordance with EREC G98 Annex A1 A.1.3.5 (**Inverter** connected) and Annex A2 A.2.3.4 (Synchronous). Please complete each entry, even if the fault contribution is zero.

For machines with electro-magnetic output	For **Inverter** output

Parameter	Symbol	Value	Time after fault	Volts	Amps
Peak Short Circuit current	i_p	NA	20 ms	61.8	14.2
Initial Value of aperiodic current	A	NA	100 ms	53.0	14.8
Initial symmetrical short-circuit current*	I_k	NA	250 ms	50.6	14.4
Decaying (aperiodic) component of short circuit current*	i_{DC}	NA	500 ms	49.9	14.2
Reactance/Resistance Ratio of source*	X/R	NA	Time to trip	2.49	In seconds

For rotating machines and linear piston machines the test should produce a 0 s – 2 s plot of the short circuit current as seen at the **Micro-generator** terminals.

* Values for these parameters should be provided where the short circuit duration is sufficiently long to enable interpolation of the plot

Logic Interface (input port)	
Confirm that an input port is provided and can be used to reduce the **Active Power** output to zero	Yes
Provide high level description of logic interface, e.g. details in 9.4.3 such as AC or **DC** signal (the additional comments box below can be used)	Yes
Self-Monitoring solid state switching: No specified test requirements. Refer to EREC G98 Annex A1 A.1.3.6 (**Inverter** connected).	Yes
It has been verified that in the event of the solid state switching device failing to disconnect the **Micro-generator**, the voltage on the output side of the switching device is reduced to a value below 50 V within 0.5 s.	
Cyber security	
Confirm that the **Manufacturer** or **Installer** of the **Micro-generator** has provided a statement describing how the **Micro-generator** has been designed to comply with cyber security requirements, as detailed in 9.7.	Yes

Additional comments

The following documents are attached to this declaration:

- "declaration about Logic Interface", as for required in "Logic Interface" section;
- "declaration about cyber-security", as for required in "Cyber security" section;

Clearline INVERTER

Form C: Type Test Verification Report

All Micro-generators connected to the **DNO Distribution Network** shall be **Fully Type Tested**. This form is the **Manufacturer**'s declaration of compliance with the requirements of EREC G98.

This form should be used when making a Type Test submission to the Energy Networks Association (ENA)Type Test Register.

If the **Micro-generator** is **Fully Type Tested** and already registered with the ENA Type Test Register, the **Installation Document** should include the **Manufacturer**'s Reference Number (the system reference), and this form does not need to be submitted.

Manufacturer's reference number	Clearline Inverter GW3600-DNS-30
Micro-generator technology	DNS G3 Grid-Connected PV Inverter (Inverter Models:GW3600-DNS-30)
Manufacturer name	Viridian Solar Limited
Address	68 Stirling Way, Papworth, Cambridge CB23 3GY, UK

Tel	+44 (0)1480 839 865	Fax	N/A
E-mail	info@viridiansolar.co.uk	Web site	www.viridiansolar.co.uk

Registered Capacity, use separate sheet if more than one connection option.	Connection Option	
	3.6	kW single phase, single, split or three phase system
	/	kW three phase
	/	kW two phases in three phase system
	/	kW two phases split phase system
Energy storage capacity for **Electricity Storage** devices		Not energy storage inverter

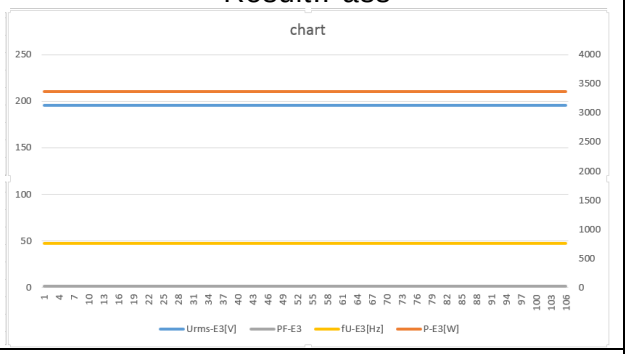
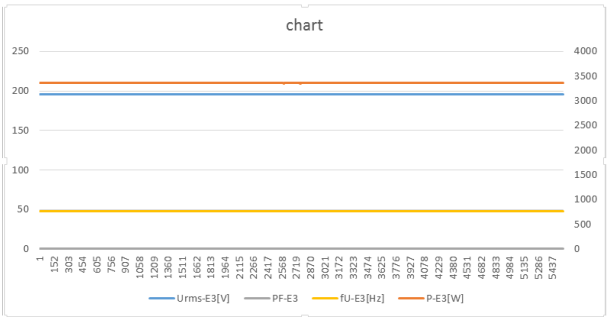
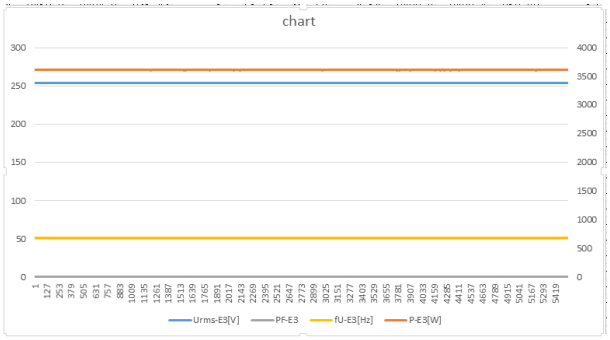
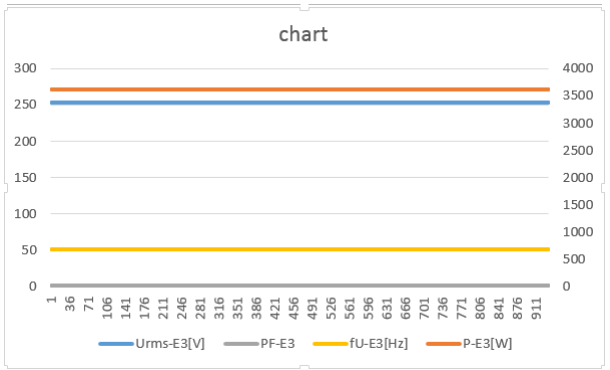
ManufacturerType Test declaration. - I certify that all products supplied by the company with the above **Fully Type Tested** reference number will be manufactured and tested to ensure that they perform as stated in this document, prior to shipment to site and that no site modifications are required to ensure that the product meets all the requirements of EREC G98.

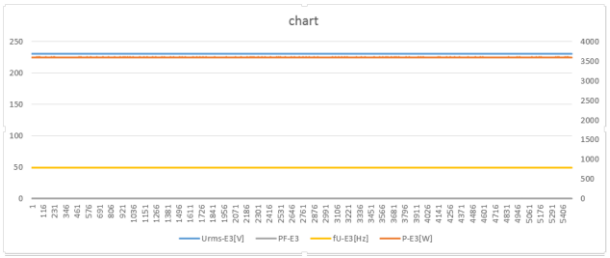
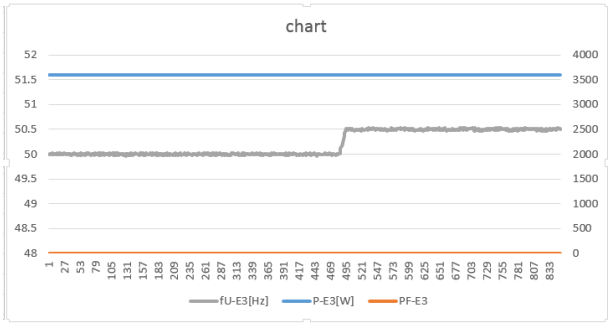
Signed	 KT Tan 8th August 2023	On behalf of	viridian solar Viridian Solar Limited

Note that testing can be done by the **Manufacturer** of an individual component or by an external test house.

Where parts of the testing are carried out by persons or organisations other than the **Manufacturer** then that person or organisation shall keep copies of all test records and results supplied to them to verify that the testing has been carried out by people with sufficient technical competency to carry out the tests.

1.**Operating Range:** This test should be carried out as specified in A.1.2.10. Pass or failure of the test should be indicated in the fields below (right hand side), for example with the statement “Pass”, “No disconnection occurs”, etc. Graphical evidence is preferred. .

Test 1 Voltage = 85% of nominal (195.5 V) Frequency = 47.0 Hz Power factor = 1 Period of test 20 seconds	Result:Pass 
Test 2 Voltage = 85% of nominal (195.5 V) Frequency = 47.5 Hz Power factor = 1 Period of test 90 minutes	Result:Pass 
Test 3 Voltage = 110% of nominal (253 V). Frequency = 51.5 Hz Power factor = 1 Period of test 90 minutes	Result:Pass 
Test 4 Voltage = 110% of nominal (253 V). Frequency = 52.0 Hz Power factor = 1 Period of test 15 minutes	Result:Pass 

Test 5 Voltage = 100% of nominal (230 V). Frequency = 50.0 Hz Power factor = 1 Period of test 90 minutes	Result:Pass 
Test 6 RoCoF withstand Confirm that the **Micro-Generating Plant** is capable of staying connected to the **Distribution Network** and operate at rates of change of frequency up to 1 Hzs^{-1} as measured over a period of 500 ms.	Result:Pass 

2.Power Quality – Harmonics: These tests should be carried out as specified in BS EN 61000-3-2. The chosen test should be undertaken with a fixed source of energy at two power levels a) between 45 and 55% and b) at 100% of **Registered Capacity**. The test requirements are specified in Annex A1 A.1.3.1 (**Inverter** connected) or Annex A2 A.2.3.1 (Synchronous).

Micro-generator tested to BS EN 61000-3-2

Micro-generator rating per phase (rpp)	3.6	kW	
For 3-phase **Micro-generator**s, tick this box if harmonic measurements are identical for all three phases. If the harmonics are not identical for each phase, please replicate this section with the results for each phase.			

Harmonic	At 45-55% of **Registered Capacity**[1]		100% of **Registered Capacity**			
	Measured Value MV in Amps		Measured Value MV in Amps		Limit in BS EN 61000-3-2 in Amps	Higher limit for odd harmonics 21 and above
2	0.022		0.030		1.080	
3	0.019		0.029		2.300	
4	0.008		0.012		0.430	
5	0.011		0.007		1.140	
6	0.004		0.008		0.300	
7	0.019		0.020		0.770	
8	0.005		0.008		0.230	
9	0.028		0.033		0.400	
10	0.004		0.007		0.184	
11	0.083		0.109		0.330	
12	0.008		0.007		0.153	
13	0.064		0.098		0.210	
14	0.006		0.006		0.131	
15	0.048		0.084		0.150	
16	0.004		0.005		0.115	

[1] See the note in A.2.3.1 if 45-55% of **Registered Capacity**is below the minimum stable operating level. If an alternative loading level is chosen, the level should be indicated on the test form and the reason for not testing at 45-55% of **Registered Capacity**should be stated. The additional comments box at the end of the harmonics test sheet can be used for this.

17	0.034		0.070		0.132	
18	0.005		0.005		0.102	
19	0.023		0.059		0.118	
20	0.005		0.006		0.092	
21	0.015		0.048		0.107	0.160
22	0.005		0.006		0.084	
23	0.009		0.039		0.098	0.147
24	0.004		0.005		0.077	
25	0.006		0.032		0.090	0.135
26	0.004		0.005		0.071	
27	0.004		0.026		0.083	0.124
28	0.004		0.005		0.066	
29	0.004		0.022		0.078	0.117
30	0.003		0.005		0.061	
31	0.004		0.017		0.073	0.109
32	0.004		0.005		0.058	
33	0.004		0.016		0.068	0.102
34	0.004		0.005		0.054	
35	0.005		0.013		0.064	0.096
36	0.005		0.005		0.051	
37	0.006		0.012		0.061	0.091
38	0.010		0.009		0.048	
39	0.010		0.014		0.058	0.087
40	0.025		0.025		0.046	

Note the higher limits for odd harmonics 21 and above are only allowable under certain conditions, if these higher limits are utilised please state the exemption used as detailed in part 6.2.3.4 of BS EN 61000-3-2 in the box below.
Additional comments:

3.**Power Quality – Voltage fluctuations and Flicker**: These tests should be undertaken in accordance with EREC G98 Annex A1 A.1.3.3 (**Inverter** connected) or Annex A2 A.2.3.3 (Synchronous).

The standard test impedance is 0.4 Ω for a single phase **Micro-generating Plant** (and for a two phase unit in a three phase system) and 0.24 Ω for a three phase **Micro-generating Plant** (and for a two phase unit in a split phase system). Please ensure that both test and standard impedance are completed on this form. If the test impedance (or the measured impedance) is different to the standard impedance, it must be normalised to the standard impedance as follows (where the **Power Factor** of the generation output is 0.98 or above):

d max normalised value = (Standard impedance / Measured impedance) x Measured value.

Where the **Power Factor** of the output is under 0.98 then the X to R ratio of the test impedance should be close to that of the standard impedance.

The stopping test should be a trip from full load operation.

The duration of these tests needs to comply with the particular requirements set out in the testing notes for the technology under test.

The test date and location must be declared.

Test start date	2022.9.21			Test end date	2022.9.21			
Test location	Test lab of GoodWe Technologies Co., Ltd (No.90 Zijin Rd., New District, Suzhou, 215011, China)							
	Starting			Stopping			Running	
	d(max)	d(c)	d(t)	d(max)	d(c)	d(t)	P_{st}	P_{lt} 2 hours
Measured Values at test impedance	0.132 %	0.108%	0.0%	0.358%	0.318%	0.0%	0.057	0.044
Normalised to standard impedance	0.132 %	0.108%	0.0%	0.358%	0.318%	0.0%	0.057	0.044
Normalised to required maximum impedance	NA	NA	NA	NA	NA	NA	NA	NA
Limits set under BS EN 61000-3-11	4%	3.3%	3.3%	4%	3.3%	3.3%	1.0	0.65

Test Impedance	R	0.4	Ω	X	0.25	Ω
Standard Impedance	R	0.24 * 0.4 ^	Ω	X	0.15 * 0.25 ^	Ω
Maximum Impedance	R	NA	Ω	X	NA	Ω

*Applies to three phase and split single phase **Micro-generators**. Delete as appropriate.

^ Applies to single phase **Micro-generators** and **Micro-generators** using two phases on a three phase system. Delete as appropriate.

4.**Power quality – DC injection:** This test should be carried out in accordance with A 1.3.4 as applicable.

The % **DC** injection ("as % of rated AC current" below) is calculated as follows:

% **DC** injection = Recorded **DC** value in Amps / base current

where the base current is the **Registered Capacity** (W) / 230 V. The % **DC** injection should not be greater than 0.25%.

Test power level	20%	50%	75%	100%
Recorded **DC** value in Amps	0.0143A	0.0144A	0.0112A	0.0124A
as % of rated AC current	0.091%	0.092%	0.072%	0.079%
Limit	0.25%	0.25%	0.25%	0.25%

5.Power Quality – Power factor: This test shall be carried out in accordance with A.1.3.2 and A.2.3.2 at three voltage levels and at **Registered Capacity** and the measured **Power Factor** must be greater than 0.95 to pass. Voltage to be maintained within ±1.5% of the stated level during the test.

	216.2 V	230 V	253 V
Measured value	0.9977	0.9978	0.9978
Power Factor Limit	>0.95	>0.95	>0.95

6.Protection – Frequency tests: These tests should be carried out in accordance with Annex A1 A.1.2.3 (**Inverter** connected) or Annex A2 A.2.2.3 (Synchronous). For trip tests, frequency and time delay should be stated. For "no trip tests", "no trip" can be stated.

Function	Setting	Trip test	"No trip tests"

	Frequency	Time delay	Frequency	Time delay	Frequency /time	Confirm no trip
U/F stage 1	47.5 Hz	20 s	47.48 Hz	20.05s	47.7 Hz 30 s	no trip
U/F stage 2	47 Hz	0.5 s	46.98 Hz	0.52s	47.2 Hz 19.5 s	no trip
					46.8 Hz 0.45 s	no trip
O/F stage 1	52 Hz	0.5 s	52.02 Hz	0.52s	51.8 Hz 120.0 s	no trip
					52.2 Hz 0.45 s	no trip

Note. For frequency trip tests the frequency required to trip is the setting ± 0.1 Hz. In order to measure the time delay a larger deviation than the minimum required to operate the projection can be used. The "No trip tests" need to be carried out at the setting ± 0.2 Hz and for the relevant times as shown in the table above to ensure that the protection will not trip in error.

7.Protection – Voltage tests: These tests should be carried out in accordance with Annex A1 A.1.2.2 (**Inverter** connected) or Annex A2 A.2.2.2 (Synchronous). For trip tests, voltage and time delay should be stated. For "no trip tests", "no trip" can be stated.

Function	Setting		Trip test		"No trip tests"	
	Voltage	Time delay	Voltage	Time delay	Voltage /time	Confirm no trip
U/V	184 V	2.5 s	183.55V	2.52s	188 V 5.0 s	no trip
					180 V 2.45 s	no trip
O/V stage 1	262.2 V	1.0 s	262.13V	1.02s	258.2 V 5.0 s	no trip
O/V stage 2	273.7 V	0.5 s	274.15	0.52s	269.7 V 0.95 s	no trip
					277.7 V 0.45 s	no trip

Note for Voltage tests the Voltage required to trip is the setting ±3.45 V. The time delay can be measured at a larger deviation than the minimum required to operate the protection. The No trip tests need to be carried out at the setting ±4 V and for the relevant times as shown in the table above to ensure that the protection will not trip in error.

8.Protection – Loss of Mains test: For PV **Inverter**s shall be tested in accordance with BS EN 62116. Other **Micro-generator**s should be tested in accordance with A.2.2.4 at 10%, 55% and 100% of rated power.

To be carried out at three output power levels with a tolerance of plus or minus 5% in Test Power levels.[2]

[2] See the note in A.2.2.4 if the suggested loading levels are below the minimum stable operating level. If alternative loading levels are chosen, the level should be indicated on the test form and the reason for not testing at 10%/55% of **Registered Capacity** should be stated. The additional comments box at the end of the loss of mains test sheet can be used for this.

Test Power	10%	55%	100%	10%	55%	100%
Balancing load on islanded network	95% of **Registered Capacity**	95% of **Registered Capacity**	95% of **Registered Capacity**	105% of **Registered Capacity**	105% of **Registered Capacity**	105% of **Registered Capacity**
Trip time. Limit is 0.5 s	NA	NA	NA	NA	NA	NA
For Multi phase **Micro-generators** confirm that the device shuts down correctly after the removal of a single fuse as well as operation of all phases.						
Test Power	10%	55%	100%	10%	55%	100%
Balancing load on islanded network	95% of **Registered Capacity**	95% of **Registered Capacity**	95% of **Registered Capacity**	105% of **Registered Capacity**	105% of **Registered Capacity**	105% of **Registered Capacity**
Trip time. Ph1 fuse removed	NA	NA	NA	NA	NA	NA
Test Power	10%	55%	100%	10%	55%	100%
Balancing load on islanded network	95% of **Registered Capacity**	95% of **Registered Capacity**	95% of **Registered Capacity**	105% of **Registered Capacity**	105% of **Registered Capacity**	105% of **Registered Capacity**
Trip time. Ph2 fuse removed	NA	NA	NA	NA	NA	NA
Test Power	10%	55%	100%	10%	55%	100%
Balancing load on islanded network	95% of **Registered Capacity**	95% of **Registered Capacity**	95% of **Registered Capacity**	105% of **Registered Capacity**	105% of **Registered Capacity**	105% of **Registered Capacity**
Trip time. Ph3 fuse removed	NA	NA	NA	NA	NA	NA
Note for technologies which have a substantial shut down time this can be added to the 0.5 s in establishing that the trip occurred in less than 0.5 s. Maximum shut down time could therefore be up to 1.0 s for these technologies.						
Indicate additional shut down time included in above results.				NA ms		
Additional comments:						

For **Inverter**s tested to BS EN 62116 the following sub set of tests should be recorded in the following table.						
Test Power and imbalance	33%	66%	100%	33%	66%	100%

	-5% Q Test 22	-5% Q Test 12	-5% P Test 5	+5% Q Test 31	+5% Q Test 21	+5% P Test 10
Trip time. Limit is 0.5 s[3]	0.470s	0.400s	0.420s	0.470s	0.490s	0.410s

9.Protection – Frequency change, Vector Shift Stability test: This test should be carried out in accordance with EREC G98 Annex A1 A.1.2.6 (**Inverter** connected) or Annex A2 A.2.2.6 (Synchronous). Confirmation is required that the **Micro-generating Plant** does not trip under positive / negative vector shift.

	Start Frequency	Change	Confirm no trip
Positive Vector Shift	49.0 Hz	+50 degrees	no trip
Negative Vector Shift	50.0 Hz	- 50 degrees	no trip

10.Protection – Frequency change, RoCoF Stability test: The requirement is specified in section 11.3, test procedure in Annex A.1.2.6 (**Inverter** connected) or Annex A2 A.2.2.6 (Synchronous). Confirmation is required that the **Micro-generating Plant** does not trip for the duration of the ramp up and ramp down test.

Ramp range	Test frequency ramp:	Test Duration	Confirm no trip
49.0 Hz to 51.0 Hz	+0.95 Hzs^{-1}	2.1 s	no trip
51.0 Hz to 49.0 Hz	-0.95 Hzs^{-1}	2.1 s	no trip

11.Limited Frequency Sensitive Mode – Over frequency test: This test should be carried out in accordance with A.1.2.8. The test should be carried out using the specific threshold frequency of 50.4 Hz and **Droop** of 10%. The measurement tolerances are contained in A.1.2.8.

Test sequence at **Registered Capacity**>80%	Measured **Active Power** Output	Frequency	Primary Power Source	**Active Power** Gradient Droop (%)
Step a) 50.00 Hz ±0.01 Hz	3598	50	3681	/
Step b) 50.45 Hz ±0.05 Hz	3559	50.45		9.23%
Step c) 50.70 Hz ±0.10 Hz	3361	50.7		9.11%
Step d) 51.15 Hz ±0.05 Hz	3007	51.15		9.14%
Step e) 50.70 Hz ±0.10 Hz	3357	50.7		8.96%
Step f) 50.45 Hz ±0.05 Hz	3568	50.45		12.00%
Step g) 50.00 Hz ±0.01 Hz	3604	50		/

[3] If the device requires additional shut down time (beyond 0.5s but less than 1s) then this should be stated on this form.

Test sequence at **Registered Capacity**40% - 60%	Measured Active Power Output	Frequency	Primary Power Source	Active Power Gradient Droop(%)
Step a) 50.00 Hz ±0.01 Hz	1805	50	1835	/
Step b) 50.45 Hz ±0.05 Hz	1766	50.45		9.23%
Step c) 50.70 Hz ±0.10 Hz	1568	50.7		9.11%
Step d) 51.15 Hz ±0.05 Hz	1212	51.15		9.11%
Step e) 50.70 Hz ±0.10 Hz	1568	50.7		9.11%
Step f) 50.45 Hz ±0.05 Hz	1767	50.45		9.47%
Step g) 50.00 Hz ±0.01 Hz	1801	50		/

12.Power output with falling frequency test: This test should be carried out in accordance with A.1.2.7.

Test sequence	Measured **Active Power** Output	Frequency	Primary power source
Test a) 50 Hz ± 0.01 Hz	3601	50	3681
Test b) Point between 49.5 Hz and 49.6 Hz	3599	49.55	3680
Test c) Point between 47.5 Hz and 47.6 Hz	3598	47.55	3680

NOTE: The operating point in Test (b) and (c) shall be maintained for at least 5 minutes

13.Re-connection timer.

Test should prove that the reconnection sequence starts after a minimum delay of 20 s for restoration of voltage and frequency to within the stage 1 settings of Table 2. Both the time delay setting and the measured delay should be provided in this form; both should be greater than 20 s to pass. Confirmation should be provided that the **Micro-generating Plant** does not reconnect at the voltage and frequency settings below; a statement of “no reconnection” can be made.

Time delay setting	Measured delay		Checks on no reconnection when voltage or frequency is brought to just outside stage 1 limits of table 2.			
48s	48s		At 266.2 V	At 180.0 V	At 47.4 Hz	At 52.1 Hz
Confirmation that the **Micro-generator** does not re-connect.			No re-connection	no re-connection	no re-connection	no re-connection

14.Fault level contribution: These tests shall be carried out in accordance with EREC G98 Annex A1 A.1.3.5 (**Inverter** connected) and Annex A2 A.2.3.4 (Synchronous). Please complete each entry, even if the fault contribution is zero.

For machines with electro-magnetic output	For **Inverter** output

Parameter	Symbol	Value	Time after fault	Volts	Amps
Peak Short Circuit current	i_p	NA	20 ms	33	17.29
Initial Value of aperiodic current	A	NA	100 ms	32.6	18.4
Initial symmetrical short-circuit current*	I_k	NA	250 ms	32.8	17.76
Decaying (aperiodic) component of short circuit current*	i_{DC}	NA	500 ms	33	17.45
Reactance/Resistance Ratio of source*	X/R	NA	Time to trip	2.75	In seconds

For rotating machines and linear piston machines the test should produce a 0 s – 2 s plot of the short circuit current as seen at the **Micro-generator** terminals.

* Values for these parameters should be provided where the short circuit duration is sufficiently long to enable interpolation of the plot

Logic Interface (input port)	
Confirm that an input port is provided and can be used to reduce the **Active Power** output to zero	Yes
Provide high level description of logic interface, e.g. details in 9.4.3 such as AC or **DC** signal (the additional comments box below can be used)	Yes
Self-Monitoring solid state switching: No specified test requirements. Refer to EREC G98 Annex A1 A.1.3.6 (**Inverter** connected).	Yes
It has been verified that in the event of the solid state switching device failing to disconnect the **Micro-generator**, the voltage on the output side of the switching device is reduced to a value below 50 V within 0.5 s.	
Cyber security	
Confirm that the **Manufacturer** or **Installer** of the **Micro-generator** has provided a statement describing how the **Micro-generator** has been designed to comply with cyber security requirements, as detailed in 9.7.	Yes
Additional comments	
The following documents are attached to this declaration: - “Clearline Inverters DNS declaration about Logic Interface”, as for required in “Logic Interface” section. - “Clearline Inverters DNS declaration about cyber-security”, as for required in “Cyber security” section;	

Clearline INVERTER

Form A2-3: Compliance Verification Report for Type A Inverter Connected Power Generating Modules

This form should be used by the **Manufacturer** to demonstrate and declare compliance with the requirements of EREC G99. The form can be used in a variety of ways as detailed below:

1. To obtain **Fully Type Tested** status (≤ 50 kW)

   The **Manufacturer** can use this form to obtain **Fully Type Tested** status for a **Power Generating Module** by registering this completed form with the Energy Networks Association (ENA) Type Test Verification Report Register. Tests 1 – 15 must all be completed and compliant for the **Power Generating Module** to be classified as **Fully Type Tested**.

2. To obtain **Type Tested** status for a product

   This form can be used by the **Manufacturer** to obtain **Type Tested** status for a product which is used in a **Power Generating Module** by registering this form with the relevant parts completed with the Energy Networks Association (ENA) Type Test Verification Report Register.
   Where the **Manufacturer** is seeking to obtain **Type Tested** status for an **Interface Protection** device the appropriate section of Form A2-4 should be used.

3. One-off Installation

   This form can be used by the **Manufacturer** or **Installer** to confirm that the **Power Generating Module** has been tested to satisfy all or part of the requirements of this EREC G99. This form shall be submitted to the **DNO** as part of the application.

A combination of (2) and (3) can be used as required, together with Form A2-4 where compliance of the **Interface Protection** is to be demonstrated on site.

Note:

Within this Form A2-3 the term **Power Park Module** will be used but its meaning can be interpreted within Form A2-3 to mean **Power Park Module**, **Generating Unit or Inverter** as appropriate for the context. However, note that compliance shall be demonstrated at the **Power Park Module** level.

If the **Power Generating Module** is **Fully Type Tested** and registered with the Energy Networks Association (ENA) Type Test Verification Report Register, the Installation Document (Form A3-1 or A3-2) should include the **Manufacturer's** reference number (the system reference), and this form does not need to be submitted.

Where the **Power Generating Module** is not registered with the ENA Type Test Verification Report Register or is not **Fully Type Tested** this form (all or in parts as applicable) needs to be completed and provided to the **DNO**, to confirm that the **Power Generating Module** has been tested to satisfy all or part of the requirements of this EREC G99.

PGM technology		DNS G3 Grid-Connected PV Inverter (Inverter Models: Clearline Inverter GW5000-DNS-30)	
Manufacturer name		Viridian Solar Limited	
Address		68 Stirling Way, Papworth, Cambridge CB23 3GY, UK	
Tel	+44 (0)1480 839 865	Web site	www.viridiansolar.co.uk
E-mail	info@viridiansolar.co.uk		

Registered Capacity	5kW
Energy storage capacity for **Electricity Storage** devices	Not energy storage inverter

There are four options for Testing: (1) **Fully Type Tested** (≤ 50 kW), (2) **Type Tested** product, (3) one-off installation, (4) tested on site at time of commissioning. The check box below indicates which tests in this Form have been completed for each of the options. With the exception of **Fully Type Tested PGM**s tests may be carried out at the time of commissioning (Form A4). **Type Tested** status is suitable for devices > 50 kW where the power quality aspects need consideration on a site by site basis in accordance with EREC G5 and EREC P28.
Insert Document reference(s) for **Manufacturers' Information**

Tested option:	**1. Fully Type Tested**	**2. Type Tested product**	**3. One-off Manufacturers' Info.**	**4. Tested on Site at time of Commissioning**
0. **Fully Type Tested** - all tests detailed below completed and evidence attached to this submission	**YES**	**N/A**	**N/A**	**N/A**
1. Operating Range	**N/A**			
2. PQ – Harmonics				
3. PQ – Voltage Fluctuation and Flicker				
4. PQ – DC Injection (**Power Park Module**s only)				
5. **Power Factor** (PF)				
6. Frequency protection trip and ride through tests				
7. Voltage protection trip and ride through tests				
8. Protection – Loss of Mains Test, Vector Shift and RoCoF Stability Test				
9. **LFSM-O** Test				
10. Protection – Reconnection Timer				
11. Fault Level Contribution				
12. Self-monitoring Solid State Switch				

There are four options for Testing: (1) **Fully Type Tested** (≤ 50 kW), (2) **Type Tested** product, (3) one-off installation, (4) tested on site at time of commissioning. The check box below indicates which tests in this Form have been completed for each of the options. With the exception of **Fully Type Tested PGM**s tests may be carried out at the time of commissioning (Form A4). **Type Tested** status is suitable for devices > 50 kW where the power quality aspects need consideration on a site by site basis in accordance with EREC G5 and EREC P28.
Insert Document reference(s) for **Manufacturers' Information**

Tested option:	**1. Fully Type Tested**	**2. Type Tested product**	**3. One-off Manufacturers' Info.**	**4. Tested on Site at time of Commissioning**
13. Wiring functional tests if required by para 15.2.1 (attach relevant schedule of tests)				
14. Logic Interface (input port)				
15. Cyber security				

Manufacturer compliance declaration. - I certify that all products supplied by the company with the above **Type Tested Manufacturer**'s reference number will be manufactured and tested to ensure that they perform as stated in this document, prior to shipment to site and that no site **Modification**s are required to ensure that the product meets all the requirements of EREC G99.

Signed	 KT Tan 6th July 2023	On behalf of	viridian solar Viridian Solar Limited

Note that testing can be done by the **Manufacturer** of an individual component or by an external test house.

Where parts of the testing are carried out by persons or organisations other than the **Manufacturer** then that person or organisation shall keep copies of all test records and results supplied to them to verify that the testing has been carried out by people with sufficient technical competency to carry out the tests.

A2-3 Compliance Verification Report –Tests for Type A Inverter Connected Power Generating Modules – test record

1. Operating Range: Tests should be carried with the **Power Generating Module** operating at **Registered Capacity** and connected to a suitable test supply or grid simulation set. The power supplied by the primary source shall be kept stable within ± 5 % of the apparent power value set for the entire duration of each test sequence.

Frequency, voltage and **Active Power** measurements at the output terminals of the **Power Generating Module** shall be recorded every second. The tests will verify that the **Power Generating Module** can operate within the required ranges for the specified period of time.

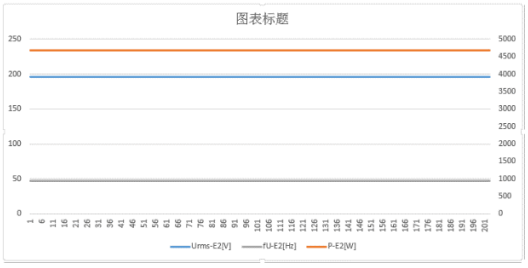
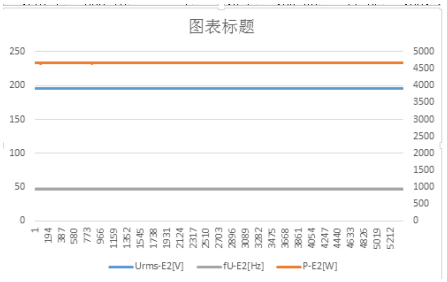
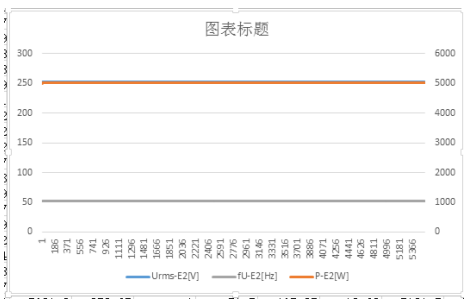
The **Interface Protection** shall be disabled during the tests.

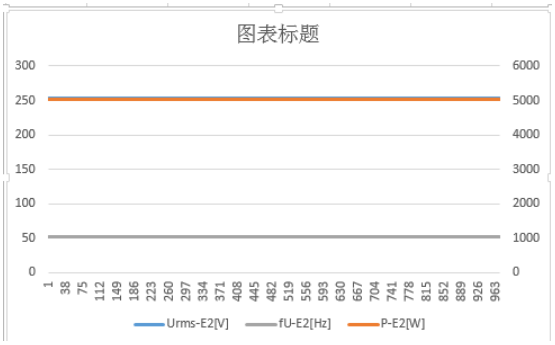
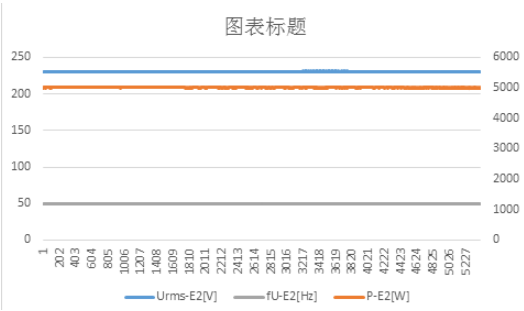
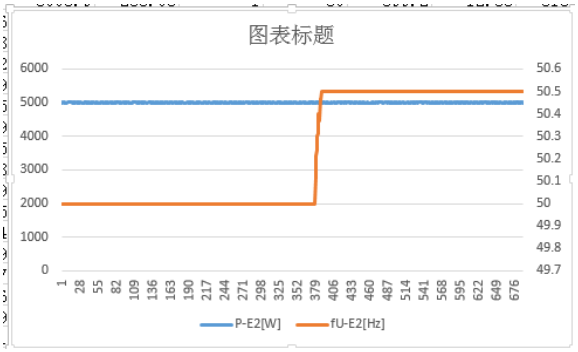
In case of a PV **Power Park Module** the PV primary source may be replaced by a DC source.

In case of a full converter **Power Park Module** (eg wind) the primary source and the prime mover I**nverter**/rectifier may be replaced by a DC source.

Pass or failure of the test should be indicated in the fields below (right hand side), for example with the statement “Pass”, “No disconnection occurs”, etc. Graphical evidence is preferred.

Note that the value of voltage stated in brackets assumes a **LV** connection. This should be adjusted for **HV** as required.

Test 1 Voltage = 85% of nominal (195.5 V), Frequency = 47 Hz, **Power Factor** = 1, Period of test 20 s	Test results : Pass 
Test 2 Voltage = 85% of nominal (195.5 V), Frequency = 47.5 Hz, **Power Factor** = 1, Period of test 90 minutes	Test results : Pass 
Test 3 Voltage = 110% of nominal (253 V)., Frequency = 51.5 Hz, **Power Factor** = 1, Period of test 90 minutes	Test results : Pass 

Test 4 Voltage = 110% of nominal (253 V), Frequency = 52.0 Hz, **Power Factor** = 1, Period of test 15 minutes	Test results : Pass 
Test 5 Voltage = 100% of nominal (230 V), Frequency = 50.0 Hz, **Power Factor** = 1, Period of test = 90 minutes	Test results : Pass 
Test 6 RoCoF withstand Confirm that the **Power Generating Module** is capable of staying connected to the **Distribution Network** and operate at rates of change of frequency up to 1 Hzs^{-1} as measured over a period of 500 ms. Note that this is not expected to be demonstrated on site.	Test results : Pass 

2. Power Quality – Harmonics:

For **Power Generating Module**s o**f Registered Capacity** of less than 75 A per phase (ie 50 kW) the test requirements are specified in Annex A.7.1.5. These tests should be carried out as specified in BS EN 61000-3-12, and measurements for the 2nd – 13th harmonics should be provided. The results need to comply with the limits of Table 2 of BS EN 61000-3-12 for single phase equipment and Table 3 of BS EN 610000-3-12 for three phase equipment. For three phase **Power Generating Module**s, measurements for all phases should be provided.
For **Power Generating Module**s o**f Registered Capacity** of greater than 75 A per phase (ie 50 kW) the installation shall be designed in accordance with EREC G5.

The rating of the **Power Generating Module** (per phase) should be provided below, and the Total Harmonic Distortion (THD) and Partial Weighted Harmonic Distortion (PWHD) should be provided at the bottom of this section.

Power Generating Module tested to BS EN 61000-3-12

Power Generating Module rating per phase (rpp)				5		kVA	Harmonic % = Measured Value (A) x 23/rating per phase (kVA)	
Single or three phase measurements (for single phase measurements, only complete L1 columns below).				Singlephase				
Harmonic	At 45-55% of **Registered Capacity**						Limit in BS EN 61000-3-12	
	Measured Value (MV) in Amps			Measured Value (MV) in %				
	L1	L2	L3	L1	L2	L3	1 phase	3 phase
2	0.0342	NA	NA	0.16	NA	NA	8%	8%
3	0.0466	NA	NA	0.21	NA	NA	21.6%	Not stated
4	0.0218	NA	NA	0.10	NA	NA	4%	4%
5	0.0168	NA	NA	0.08	NA	NA	10.7%	10.7%
6	0.0150	NA	NA	0.07	NA	NA	2.67%	2.67%
7	0.0234	NA	NA	0.11	NA	NA	7.2%	7.2%
8	0.0105	NA	NA	0.05	NA	NA	2%	2%
9	0.0349	NA	NA	0.16	NA	NA	3.8%	Not stated
10	0.0090	NA	NA	0.04	NA	NA	1.6%	1.6%
11	0.1207	NA	NA	0.56	NA	NA	3.1%	3.1%
12	0.0088	NA	NA	0.04	NA	NA	1.33%	1.33%
13	0.1144	NA	NA	0.53	NA	NA	2%	2%
THD[1]	NA	NA	NA	1.34	NA	NA	23%	13%
PWHD[2]	NA	NA	NA	2.19	NA	NA	23%	22%
Harmonic	At 100% of **Registered Capacity**						Limit in BS EN 61000-3-12	
	Measured value (MV) in Amps			Measured value (MV) in %				
	L1	L2	L3	L1	L2	L3	1 phase	3 phase
2	0.0125	NA	NA	0.06	NA	NA	8%	8%
3	0.0217	NA	NA	0.10	NA	NA	21.6%	Not stated

[1] THD = Total Harmonic Distortion
[2] PWHD = Partial Weighted Harmonic Distortion

4	0.0089	NA	NA	0.04	NA	NA	4%	4%
5	0.0085	NA	NA	0.04	NA	NA	10.7%	10.7%
6	0.0052	NA	NA	0.02	NA	NA	2.67%	2.67%
7	0.0198	NA	NA	0.09	NA	NA	7.2%	7.2%
8	0.0068	NA	NA	0.03	NA	NA	2%	2%
9	0.0302	NA	NA	0.14	NA	NA	3.8%	Not stated
10	0.0053	NA	NA	0.02	NA	NA	1.6%	1.6%
11	0.0988	NA	NA	0.45	NA	NA	3.1%	3.1%
12	0.0056	NA	NA	0.03	NA	NA	1.33%	.33%
13	0.0831	NA	NA	0.38	NA	NA	2%	2%
THD[3]	NA	NA	NA	1.79	NA	NA	23%	13%
PWHD[4]	NA	NA	NA	2.98	NA	NA	23%	22%

3. Power Quality – Voltage fluctuations and Flicker:

For **Power Generating Module**s o**f Registered Capacity** of less than 75 A per phase (ie 50 kW) these tests should be undertaken in accordance with Annex A.7.1.4.3. Results should be normalised to a standard source impedance, or if this results in figures above the limits set in BS EN 61000-3-11 to a suitable Maximum Impedance.

For **Power Generating Module**s o**f Registered Capacity** of greater than 75 A per phase (ie 50 kW) the installation shall be designed in accordance with EREC P28.

The standard test impedance is 0.4 Ω for a single phase **Power Generating Module** (and for a two phase unit in a three phase system) and 0.24 Ω for a three phase **Power Generating Module** (and for a two phase unit in a split phase system). Please ensure that both test and standard impedance are completed on this form. If the test impedance (or the measured impedance) is different to the standard impedance, it must be normalised to the standard impedance as follows (where the **Power Factor** of the generation output is 0.98 or above):

d max normalised value = (Standard impedance / Measured impedance) x Measured value.

Where the **Power Factor** of the output is under 0.98 then the X to R ratio of the test impedance should be close to that of the standard impedance.

The stopping test should be a trip from full load operation.

The duration of these tests needs to comply with the particular requirements set out in the testing notes for the technology under test.

The test date and location must be declared.

Test start date	2022.9.20	Test end date	2022.9.21

[3] THD = Total Harmonic Distortion
[4] PWHD = Partial Weighted Harmonic Distortion

Test location		Test lab of GoodWe Technologies Co., Ltd (No.90 Zijin Rd., New District, Suzhou, 215011, China)						
	Starting			Stopping			Running	
	d max	d c	d(t)	d max	d c	d(t)	P st	P lt 2 hours
Measured Values at test impedance	0.398%	0.081%	0%	0.113%	0.085%	0%	0.044	0.041
Normalised to standard impedance	0.398%	0.081%	0%	0.113%	0.085%	0%	0.044	0.041
Normalised to required maximum impedance	NA	NA	NA	NA	NA	NA	NA	NA
Limits set under BS EN 61000-3-11	4%	3.3%	3.3%	4%	3.3%	3.3%	1.0	0.65

Test Impedance	R	0.4	Ω	XI	0.25	Ω
Standard Impedance	R	0.24 * 0.4 ^	Ω	XI	0.15 * 0.25 ^	Ω
Maximum Impedance	R	NA	Ω	XI	NA	Ω

* Applies to three phase and split single phase **Power Generating Module**s. Delete as appropriate.

^ Applies to single phase **Power Generating Module** and **Power Generating Module**s using two phases on a three phase system. Delete as appropriate.

4. Power quality – DC injection: The tests should be carried out on a single **Generating Unit**. Tests are to be carried out at three defined power levels ±5%. At 230 V a 50 kW three phase **Inverter** has a current output of 217 A so DC limit is 543 mA. These tests should be undertaken in accordance with Annex A.7.1.4.4.

The % DC injection ("as % of rated AC current" below) is calculated as follows:

% DC injection = Recorded DC value in Amps / Base current

where the base current is the **Registered Capacity** (W) / V phase. The % DC injection should not be greater than 0.25%.

Test power level	10%	55%	100%
Recorded DC value in Amps	0.0204	0.0025	0.0264
as % of rated AC current	0.094%	0.012%	0.121%
Limit	0.25%	0.25%	0.25%

5. Power Factor: The tests should be carried out on a single **Power Generating Module**. Tests are to be carried out at three voltage levels and at **Registered Capacity** and the measured **Power Factor** must be greater than 0.95 to pass. Voltage to be maintained within ±1.5% of the stated level during the test. These tests should be undertaken in accordance with Annex A.7.1.4.2.

Note that the value of voltage stated in brackets assumes a **LV** connection. This should be adjusted for **HV** as required.

Voltage	0.94 pu (216.2 V)	1 pu (230 V)	1.1 pu (253 V)
Measured value	0.999	0.998	0.999
Power Factor Limit	>0.95	>0.95	>0.95

6. Protection – Frequency tests: These tests should be carried out in accordance with the Annex A.7.1.2.3. For trip tests, frequency and time delay should be stated. For "no trip tests", "no trip" can be stated.

Function	Setting		Trip test		"No trip tests"	
	Frequency	Time delay	Frequency	Time delay	Frequency /time	Confirm no trip
U/F stage 1	47.5 Hz	20 s	47.48Hz	20.05s	47.7 Hz	no trip

					30 s	
U/F stage 2	47 Hz	0.5 s	46.98 Hz	0.53s	47.2 Hz 19.5 s	no trip
					46.8 Hz 0.45 s	no trip
O/F	52 Hz	0.5 s	52.02 Hz	0.53s	51.8 Hz 120.0 s	no trip
					52.2 Hz 0.45 s	no trip
Note. For frequency trip tests the frequency required to trip is the setting ± 0.1 Hz. In order to measure the time delay a larger deviation than the minimum required to operate the projection can be used. The "No trip tests" need to be carried out at the setting ± 0.2 Hz and for the relevant times as shown in the table above to ensure that the protection will not trip in error.						
7. Protection – Voltage tests: These tests should be carried out in accordance with Annex A.7.1.2.2. For trip tests, voltage and time delay should be stated. For "no trip tests", "no trip" can be stated. Note that the value of voltage stated below assumes a **LV** connection This should be adjusted for **HV** taking account of the VT ratio as required.						
Function	Setting		Trip test		"No trip tests"	
	Voltage	Time delay	Voltage	Time delay	Voltage /time	Confirm no trip
U/V	0.8 pu (184 V)	2.5 s	183.80V	2.54s	188V 5.0 s	no trip
					180V 2.45 s	no trip
O/V stage 1	1.14 pu (262.2 V)	1.0 s	263.75V	1.02s	258.2 V 5.0 s	no trip
O/V stage 2	1.19 pu (273.7 V)	0.5 s	274.80V	0.53s	269.7 V 0.95 s	no trip
					277.7 V 0.45 s	no trip
Note for Voltage tests the Voltage required to trip is the setting ±3.45 V. The time delay can be measured at a larger deviation than the minimum required to operate the protection. The No trip tests need to be carried out at the setting ±4 V and for the relevant times as shown in the table above to ensure that the protection will not trip in error.						

8.Protection – Loss of Mains test: These tests should be carried out in accordance with BS EN 62116. Annex A.7.1.2.4.						
The following sub set of tests should be recorded in the following table.						
Test Power and imbalance	33% -5% Q Test 22	66% -5% Q Test 12	100% -5% P Test 5	33% +5% Q Test 31	66% +5% Q Test 21	100% +5% P Test 10
Trip time. Limit is 0.5s[5]	0.470s	0.400s	0.420s	0.470s	0.490s	0.410s
9.Loss of Mains Protection, Vector Shift Stability test: This test should be carried out in accordance with Annex A.7.1.2.6. Confirmation is required that the **Power Generating Module** does not trip under positive / negative vector shift.						
	Start Frequency	Change	Confirm no trip			
Positive Vector Shift	49.5 Hz	+50 degrees	no trip			
Negative Vector Shift	50.5 Hz	- 50 degrees	no trip			
10.Loss of Mains Protection, RoCoF Stability test: This test should be carried out in accordance with Annex A.7.1.2.6. Confirmation is required that the **Power Generating Module** does not trip for the duration of the ramp up and ramp down test.						
Ramp range	Test frequency ramp:		Test Duration			Confirm no trip
49.0 Hz to 51.0 Hz	+0.95 Hzs^{-1}		2.1 s			no trip
51.0 Hz to 49.0 Hz	-0.95 Hzs^{-1}		2.1 s			no trip
11. Limited Frequency Sensitive Mode – Over frequency test: The test should be carried out using the specific threshold frequency of 50.4 Hz and **Droop** of 10%. This test should be carried out in accordance with Annex A.7.1.3, which also contains the measurement tolerances.						
Active Power response to rising frequency/time plots are attached if frequency injection tests are undertaken in accordance with Annex A.7.2.4.					**NA**	
Alternatively, test results should be noted below:						
Test sequence at **Registered Capacity**>80%	Measured **Active Power** Output	Frequency	Primary Power Source		**Active Power** Gradient	

[5]If the device requires additional shut down time (beyond 0.5 s but less than 1 s) then this should be stated on this form.

				Droop (%)
Step a) 50.00Hz ±0.01Hz	4994	50	5132	/
Step b) 50.45Hz ±0.05Hz	4941	50.45		9.43%
Step c) 50.70Hz ±0.10Hz	4667	50.7		9.17%
Step d) 51.15Hz ±0.05Hz	4186	51.15		9.28%
Step e) 50.70Hz ±0.10Hz	4677	50.7		9.46%
Step f) 50.45Hz ±0.05Hz	4949	50.45		11.11%
Step g) 50.00Hz ±0.01Hz	5000	50		/
Test sequence at **Registered Capacity** 40% - 60%	Measured Active Power Output	Frequency	Primary Power Source	Active Power Gradient Droop (%)
Step a) 50.00Hz ±0.01Hz	2515	50	2563	/
Step b) 50.45Hz ±0.05Hz	2462	50.45		9.43%
Step c) 50.70Hz ±0.10Hz	2189	50.7		9.20%
Step d) 51.15Hz ±0.05Hz	1695	51.15		9.15%
Step e) 50.70Hz ±0.10Hz	2189	50.70		9.20%
Step f) 50.45Hz ±0.05Hz	2463	50.45	2505	9.62%
Step g) 50.00Hz ±0.01Hz	2513	50	2560	/

12. Protection – Re-connection timer					
Test should prove that the reconnection sequence starts after a minimum delay of 20 s for restoration of voltage and frequency to within the stage 1 settings of Table 10.1. Both the time delay setting and the measured delay should be provided in this form; both should be greater than 20 s to pass. Confirmation should be provided that the **Power Generating Module** does not reconnect at the voltage and frequency settings below; a statement of "no reconnection" can be made.					
Time delay setting	Measured delay	Checks on no reconnection when voltage or frequency is brought to just outside stage 1 limits of Table 10.1.			
48s	48s	At 1.16 pu (266.2 V **LV** connection, 127.6 V **HV** connection assuming 110 V ph-ph VT)	At 0.78 pu (180.0 V **LV** connection, 85.8 V **HV** connection assuming 110 V ph-ph VT)	At 47.4 Hz	At 52.1 Hz
Confirmation that the **Power Generating Module** does not re-connect.		no re-connection	no re-connection	no re-connection	no re-connection

13. Fault level contribution: These tests shall be carried out in accordance with EREC G99 Annex A.7.1.5. Please complete each entry, even if the contribution to the fault level is zero.		
For **Inverter** output		
Time after fault	Volts	Amps
20ms	32	17.3
100ms	39.2	24.33
250ms	35.5	24.25
500ms	34.3	24.05
Time to trip	2.74	In seconds

14. Self-Monitoring solid state switching: No specified test requirements. Refer to Annex A.7.1.6.	
It has been verified that in the event of the solid state switching device failing to disconnect the **Power Park Module**, the voltage on the output side of the switching device is reduced to a value below 50 volts within 0.5 s.	Yes

15. Wiring functional tests: If required by para 15.2.1.	
Confirm that the relevant test schedule is attached (tests to be undertaken at time of commissioning)	NA

16. Logic interface (input port)	
Confirm that an input port is provided and can be used to shut down the module	Yes

Provide high level description of logic interface, e.g. details in 11.1.3.1 such as AC or DC signal (the additional comments box below can be used)	Yes
17. Cyber security	
Confirm that the **Power Generating Module** has been designed to comply with cyber security requirements, as detailed in 9.1.7.	Yes
Additional comments.	
The following documents are attached to this declaration: - "Clearline Inverters DNS declaration about Logic Interface", as for required in section 14; - "Clearline Inverters DNS declaration about Cyber-security", as for required in section 15;	

Clearline INVERTER

Form A2-3: Compliance Verification Report for Type A Inverter Connected Power Generating Modules

This form should be used by the **Manufacturer** to demonstrate and declare compliance with the requirements of EREC G99. The form can be used in a variety of ways as detailed below:

1. To obtain **Fully Type Tested** status (≤ 50 kW)

   The **Manufacturer** can use this form to obtain **Fully Type Tested** status for a **Power Generating Module** by registering this completed form with the Energy Networks Association (ENA) Type Test Verification Report Register. Tests 1 – 15 must all be completed and compliant for the **Power Generating Module** to be classified as **Fully Type Tested**.

2. To obtain **Type Tested** status for a product

   This form can be used by the **Manufacturer** to obtain **Type Tested** status for a product which is used in a **Power Generating Module** by registering this form with the relevant parts completed with the Energy Networks Association (ENA) Type Test Verification Report Register.
   Where the **Manufacturer** is seeking to obtain **Type Tested** status for an **Interface Protection** device the appropriate section of Form A2-4 should be used.

3. One-off Installation

   This form can be used by the **Manufacturer** or **Installer** to confirm that the **Power Generating Module** has been tested to satisfy all or part of the requirements of this EREC G99. This form shall be submitted to the **DNO** as part of the application.

A combination of (2) and (3) can be used as required, together with Form A2-4 where compliance of the **Interface Protection** is to be demonstrated on site.

Note:

Within this Form A2-3 the term **Power Park Module** will be used but its meaning can be interpreted within Form A2-3 to mean **Power Park Module**, **Generating Unit or Inverter** as appropriate for the context. However, note that compliance shall be demonstrated at the **Power Park Module** level.

If the **Power Generating Module** is **Fully Type Tested** and registered with the Energy Networks Association (ENA) Type Test Verification Report Register, the Installation Document (Form A3-1 or A3-2) should include the **Manufacturer's** reference number (the system reference), and this form does not need to be submitted.

Where the **Power Generating Module** is not registered with the ENA Type Test Verification Report Register or is not **Fully Type Tested** this form (all or in parts as applicable) needs to be completed and provided to the **DNO**, to confirm that the **Power Generating Module** has been tested to satisfy all or part of the requirements of this EREC G99.

PGM technology		DNS G3Grid-Connected PV Inverter (Inverter Models: Clearline Inverter GW6000-DNS-30)	
Manufacturer name		Viridian Solar Limited	
Address		68 Stirling Way, Papworth, Cambridge CB23 3GY, UK	
Tel	+44 (0)1480 839 865	Tel	+44 (0)1480 839 865
E-mail	info@viridiansolar.co.uk		

Registered Capacity	6kW
Energy storage capacity for **Electricity Storage** devices	Not energy storage inverter

There are four options for Testing: (1) **Fully Type Tested** (≤ 50 kW), (2) **Type Tested** product, (3) one-off installation, (4) tested on site at time of commissioning. The check box below indicates which tests in this Form have been completed for each of the options. With the exception of **Fully Type Tested PGM**s tests may be carried out at the time of commissioning (Form A4). **Type Tested** status is suitable for devices > 50 kW where the power quality aspects need consideration on a site by site basis in accordance with EREC G5 and EREC P28.
Insert Document reference(s) for **Manufacturers' Information**

Tested option:	**1. Fully Type Tested**	**2. Type Tested product**	**3. One-off Manufacturers' Info.**	**4. Tested on Site at time of Commissioning**
0. **Fully Type Tested** - all tests detailed below completed and evidence attached to this submission	**YES**	**N/A**	**N/A**	**N/A**
1. Operating Range	**N/A**			
2. PQ – Harmonics				
3. PQ – Voltage Fluctuation and Flicker				
4. PQ – DC Injection (**Power Park Module**s only)				
5. **Power Factor** (PF)				
6. Frequency protection trip and ride through tests				
7. Voltage protection trip and ride through tests				
8. Protection – Loss of Mains Test, Vector Shift and RoCoF Stability Test				
9. **LFSM-O** Test				
10. Protection – Reconnection Timer				
11. Fault Level Contribution				
12. Self-monitoring Solid State Switch				

Clearline INVERTER

There are four options for Testing: (1) **Fully Type Tested** (≤ 50 kW), (2) **Type Tested** product, (3) one-off installation, (4) tested on site at time of commissioning. The check box below indicates which tests in this Form have been completed for each of the options. With the exception of **Fully Type Tested PGM**s tests may be carried out at the time of commissioning (Form A4). **Type Tested** status is suitable for devices > 50 kW where the power quality aspects need consideration on a site by site basis in accordance with EREC G5 and EREC P28.
Insert Document reference(s) for **Manufacturers' Information**

Tested option:	**1. Fully Type Tested**	**2. Type Tested product**	**3. One-off Manufacturers' Info.**	**4. Tested on Site at time of Commissioning**
13. Wiring functional tests if required by para 15.2.1 (attach relevant schedule of tests)				
14. Logic Interface (input port)				
15. Cyber security				

Manufacturer compliance declaration. - I certify that all products supplied by the company with the above **Type Tested Manufacture**r's reference number will be manufactured and tested to ensure that they perform as stated in this document, prior to shipment to site and that no site **Modification**s are required to ensure that the product meets all the requirements of EREC G99.

Signed	 KT Tan 6th July 2023	On behalf of	viridian solar Viridian Solar Limited

Note that testing can be done by the **Manufacturer** of an individual component or by an external test house.

Where parts of the testing are carried out by persons or organisations other than the **Manufacturer** then that person or organisation shall keep copies of all test records and results supplied to them to verify that the testing has been carried out by people with sufficient technical competency to carry out the tests.

A2-3 Compliance Verification Report –Tests for Type A Inverter Connected Power Generating Modules – test record

1. Operating Range: Tests should be carried with the **Power Generating Module** operating at **Registered Capacity** and connected to a suitable test supply or grid simulation set. The power supplied by the primary source shall be kept stable within ± 5 % of the apparent power value set for the entire duration of each test sequence.

Frequency, voltage and **Active Power** measurements at the output terminals of the **Power Generating Module** shall be recorded every second. The tests will verify that the **Power Generating Module** can operate within the required ranges for the specified period of time.

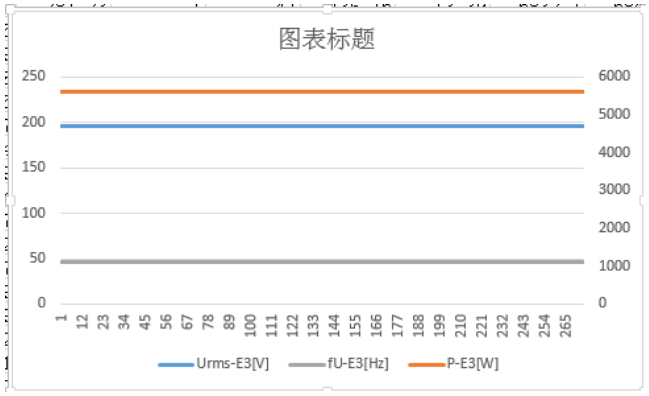
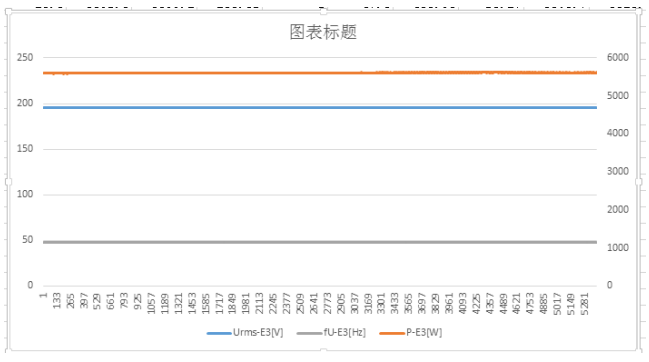
The **Interface Protection** shall be disabled during the tests.

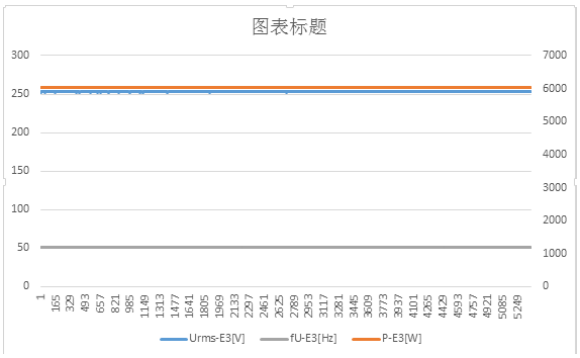
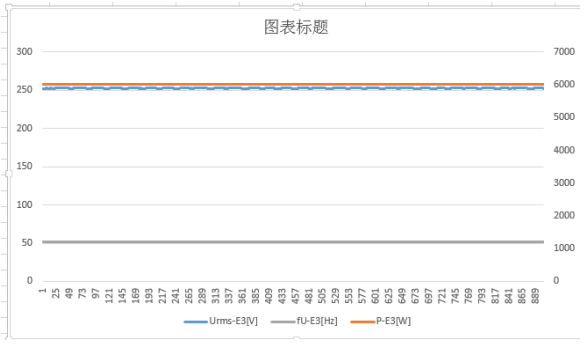
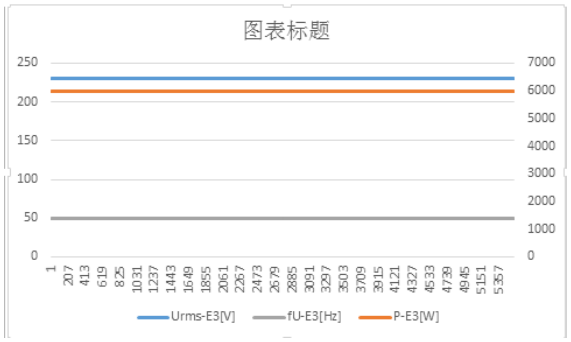
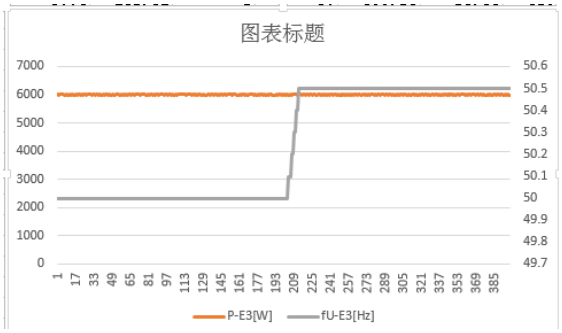
In case of a PV **Power Park Module** the PV primary source may be replaced by a DC source.

In case of a full converter **Power Park Module** (eg wind) the primary source and the prime mover I**nverter**/rectifier may be replaced by a DC source.

Pass or failure of the test should be indicated in the fields below (right hand side), for example with the statement “Pass”, “No disconnection occurs”, etc. Graphical evidence is preferred.

Note that the value of voltage stated in brackets assumes a **LV** connection. This should be adjusted for **HV** as required.

Test 1 Voltage = 85% of nominal (195.5 V), Frequency = 47 Hz, **Power Factor** = 1, Period of test 20 s	Test results : Pass 
Test 2 Voltage = 85% of nominal (195.5 V), Frequency = 47.5 Hz, **Power Factor** = 1, Period of test 90 minutes	Test results : Pass 

Test 3 Voltage = 110% of nominal (253 V)., Frequency = 51.5 Hz, **Power Factor** = 1, Period of test 90 minutes	Test results : Pass 
Test 4 Voltage = 110% of nominal (253 V), Frequency = 52.0 Hz, **Power Factor** = 1, Period of test 15 minutes	Test results : Pass 
Test 5 Voltage = 100% of nominal (230 V), Frequency = 50.0 Hz, **Power Factor** = 1, Period of test = 90 minutes	Test results : Pass 
Test 6 RoCoF withstand Confirm that the **Power Generating Module** is capable of staying connected to the **Distribution Network** and operate at rates of change of frequency up to 1 Hzs^{-1} as measured over a period of 500 ms. Note that this is not expected to be demonstrated on site.	Test results : Pass 

2. Power Quality – Harmonics:

For **Power Generating Module**s of **Registered Capacity** of less than 75 A per phase (ie 50 kW) the test requirements are specified in Annex A.7.1.5. These tests should be carried out as specified in BS EN 61000-3-12, and measurements for the 2nd – 13th harmonics should be provided. The results need to comply with the limits of Table 2 of BS EN 61000-3-12 for single phase equipment and Table 3 of BS EN 610000-3-12 for three phase equipment. For three phase **Power Generating Module**s, measurements for all phases should be provided.
For **Power Generating Module**s of **Registered Capacity** of greater than 75 A per phase (ie 50 kW) the installation shall be designed in accordance with EREC G5.

The rating of the **Power Generating Module** (per phase) should be provided below, and the Total Harmonic Distortion (THD) and Partial Weighted Harmonic Distortion (PWHD) should be provided at the bottom of this section.

Power Generating Module tested to BS EN 61000-3-12

Power Generating Module rating per phase (rpp)			6		kVA		Harmonic % = Measured Value (A) x 23/rating per phase (kVA)	
Single or three phase measurements (for single phase measurements, only complete L1 columns below).			Single phase					
Harmonic	At 45-55% of **Registered Capacity**						Limit in BS EN 61000-3-12	
	Measured Value (MV) in Amps			Measured Value (MV) in %				
	L1	L2	L3	L1	L2	L3	1 phase	3 phase
2	0.0248	NA	NA	0.09	NA	NA	8%	8%
3	0.0113	NA	NA	0.04	NA	NA	21.6%	Not stated
4	0.0123	NA	NA	0.05	NA	NA	4%	4%
5	0.0082	NA	NA	0.03	NA	NA	10.7%	10.7%
6	0.0229	NA	NA	0.09	NA	NA	2.67%	2.67%
7	0.0121	NA	NA	0.05	NA	NA	7.2%	7.2%
8	0.0319	NA	NA	0.12	NA	NA	2%	2%
9	0.0072	NA	NA	0.03	NA	NA	3.8%	Not stated
10	0.1049	NA	NA	0.40	NA	NA	1.6%	1.6%
11	0.0062	NA	NA	0.02	NA	NA	3.1%	3.1%
12	0.0897	NA	NA	0.34	NA	NA	1.33%	1.33%
13	0.0059	NA	NA	0.02	NA	NA	2%	2%

THD[1]	NA	NA	NA	1.57	NA	NA	23%	13%
PWHD[2]	NA	NA	NA	2.19	NA	NA	23%	22%
Harmonic	At 100% of **Registered Capacity**						Limit in BS EN 61000-3-12	
	Measured value (MV) in Amps			Measured value (MV) in %				
	L1	L2	L3	L1	L2	L3	1 phase	3 phase
2	0.0443	NA	NA	0.17	NA	NA	8%	8%
3	0.0367	NA	NA	0.14	NA	NA	21.6%	Not stated
4	0.0171	NA	NA	0.07	NA	NA	4%	4%
5	0.0140	NA	NA	0.05	NA	NA	10.7%	10.7%
6	0.0103	NA	NA	0.04	NA	NA	2.67%	2.67%
7	0.0304	NA	NA	0.12	NA	NA	7.2%	7.2%
8	0.0101	NA	NA	0.04	NA	NA	2%	2%
9	0.0379	NA	NA	0.15	NA	NA	3.8%	Not stated
10	0.0100	NA	NA	0.04	NA	NA	1.6%	1.6%
11	0.1306	NA	NA	0.50	NA	NA	3.1%	3.1%
12	0.0076	NA	NA	0.03	NA	NA	1.33%	.33%
13	0.1198	NA	NA	0.46	NA	NA	2%	2%
THD[3]	NA	NA	NA	1.15	NA	NA	23%	13%
PWHD[4]	NA	NA	NA	2.98	NA	NA	23%	22%

[1] THD = Total Harmonic Distortion
[2] PWHD = Partial Weighted Harmonic Distortion
[3] THD = Total Harmonic Distortion
[4] PWHD = Partial Weighted Harmonic Distortion

3. Power Quality – Voltage fluctuations and Flicker:

For **Power Generating Module**s of **Registered Capacity** of less than 75 A per phase (ie 50 kW) these tests should be undertaken in accordance with Annex A.7.1.4.3. Results should be normalised to a standard source impedance, or if this results in figures above the limits set in BS EN 61000-3-11 to a suitable Maximum Impedance.

For **Power Generating Module**s of **Registered Capacity** of greater than 75 A per phase (ie 50 kW) the installation shall be designed in accordance with EREC P28.

The standard test impedance is 0.4 Ω for a single phase **Power Generating Module** (and for a two phase unit in a three phase system) and 0.24 Ω for a three phase **Power Generating Module** (and for a two phase unit in a split phase system). Please ensure that both test and standard impedance are completed on this form. If the test impedance (or the measured impedance) is different to the standard impedance, it must be normalised to the standard impedance as follows (where the **Power Factor** of the generation output is 0.98 or above):

d max normalised value = (Standard impedance / Measured impedance) x Measured value.

Where the **Power Factor** of the output is under 0.98 then the X to R ratio of the test impedance should be close to that of the standard impedance.

The stopping test should be a trip from full load operation.

The duration of these tests needs to comply with the particular requirements set out in the testing notes for the technology under test.

The test date and location must be declared.

Test start date	2022.9.20	Test end date	2022.9.21
Test location	Test lab of GoodWe Technologies Co., Ltd (No.90 Zijin Rd., New District, Suzhou, 215011, China)		

	Starting			Stopping			Running	
	d max	d c	d(t)	d max	d c	d(t)	P st	P lt 2 hours
Measured Values at test impedance	1.110%	1.071%	0%	1.421%	0.081%	0%	0.208	0.163
Normalised to standard impedance	1.110%	1.071%	0%	1.421%	0.081%	0%	0.208	0.163
Normalised to required maximum impedance	NA	NA	NA	NA	NA	NA	NA	NA
Limits set under BS EN 61000-3-11	4%	3.3%	3.3%	4%	3.3%	3.3%	1.0	0.65

Test Impedance	R	0.4	Ω	XI	0.25	Ω
Standard Impedance	R	0.24 * 0.4 ^	Ω	XI	0.15 * 0.25 ^	Ω
Maximum Impedance	R	NA	Ω	XI	NA	Ω

* Applies to three phase and split single phase **Power Generating Module**s. Delete as appropriate.

^ Applies to single phase **Power Generating Module** and **Power Generating Module**s using two phases on a three phase system. Delete as appropriate.

4. Power quality – DC injection: The tests should be carried out on a single **Generating Unit**. Tests are to be carried out at three defined power levels ±5%. At 230 V a 50 kW three phase **Inverter** has a current output of 217 A so DC limit is 543 mA. These tests should be undertaken in accordance with Annex A.7.1.4.4.

The % DC injection ("as % of rated AC current" below) is calculated as follows:

% DC injection = Recorded DC value in Amps / Base current

where the base current is the **Registered Capacity** (W) / V phase. The % DC injection should not be greater than 0.25%.

Test power level	10%	55%	100%
Recorded DC value in Amps	0.0190	0.0493	0.0423
as % of rated AC current	0.073%	0.189%	0.162%
Limit	0.25%	0.25%	0.25%

5. Power Factor: The tests should be carried out on a single **Power Generating Module**. Tests are to be carried out at three voltage levels and at **Registered Capacity** and the measured **Power Factor** must be greater than 0.95 to pass. Voltage to be maintained within ±1.5% of the stated level during the test. These tests should be undertaken in accordance with Annex A.7.1.4.2.

Note that the value of voltage stated in brackets assumes a **LV** connection. This should be adjusted for **HV** as required.

Voltage	0.94 pu (216.2 V)	1 pu (230 V)	1.1 pu (253 V)
Measured value	0.999	0.999	0.999
Power Factor Limit	>0.95	>0.95	>0.95

6. Protection – Frequency tests: These tests should be carried out in accordance with the Annex A.7.1.2.3. For trip tests, frequency and time delay should be stated. For "no trip tests", "no trip" can be stated.

Function	Setting		Trip test		"No trip tests"	
	Frequency	Time delay	Frequency	Time delay	Frequency /time	Confirm no trip
U/F stage 1	47.5 Hz	20 s	47.48 Hz	20.06s	47.7 Hz	no trip

					30 s	
U/F stage 2	47 Hz	0.5 s	46.98 Hz	0.55s	47.2 Hz 19.5 s	no trip
					46.8 Hz 0.45 s	no trip
O/F	52 Hz	0.5 s	52.02 Hz	0.55s	51.8 Hz 120.0 s	no trip
					52.2 Hz 0.45 s	no trip
Note. For frequency trip tests the frequency required to trip is the setting ± 0.1 Hz. In order to measure the time delay a larger deviation than the minimum required to operate the projection can be used. The "No trip tests" need to be carried out at the setting ± 0.2 Hz and for the relevant times as shown in the table above to ensure that the protection will not trip in error.						
7. Protection – Voltage tests: These tests should be carried out in accordance with Annex A.7.1.2.2. For trip tests, voltage and time delay should be stated. For "no trip tests", "no trip" can be stated. Note that the value of voltage stated below assumes a **LV** connection This should be adjusted for **HV** taking account of the VT ratio as required.						
Function	Setting		Trip test		"No trip tests"	
	Voltage	Time delay	Voltage	Time delay	Voltage /time	Confirm no trip
U/V	0.8 pu (184 V)	2.5 s	183.41V	2.54s	188V 5.0 s	no trip
					180V 2.45 s	no trip
O/V stage 1	1.14 pu (262.2 V)	1.0 s	263.31V	1.03s	258.2 V 5.0 s	no trip
O/V stage 2	1.19 pu (273.7 V)	0.5 s	274.84V	0.54s	269.7 V 0.95 s	no trip
					277.7 V 0.45 s	no trip
Note for Voltage tests the Voltage required to trip is the setting ±3.45 V. The time delay can be measured at a larger deviation than the minimum required to operate the protection. The No trip tests need to be carried out at the setting ±4 V and for the relevant times as shown in the table above to ensure that the protection will not trip in error.						

8.Protection – Loss of Mains test: These tests should be carried out in accordance with BS EN 62116. Annex A.7.1.2.4.						
The following sub set of tests should be recorded in the following table.						
Test Power and imbalance	33% -5% Q Test 22	66% -5% Q Test 12	100% -5% P Test 5	33% +5% Q Test 31	66% +5% Q Test 21	100% +5% P Test 10
Trip time. Limit is 0.5s[5]	0.470s	0.400s	0.420s	0.470s	0.490s	0.410s

9.Loss of Mains Protection, Vector Shift Stability test: This test should be carried out in accordance with Annex A.7.1.2.6. Confirmation is required that the **Power Generating Module** does not trip under positive / negative vector shift.			
	Start Frequency	Change	Confirm no trip
Positive Vector Shift	49.5 Hz	+50 degrees	no trip
Negative Vector Shift	50.5 Hz	- 50 degrees	no trip

10.Loss of Mains Protection, RoCoF Stability test: This test should be carried out in accordance with Annex A.7.1.2.6. Confirmation is required that the **Power Generating Module** does not trip for the duration of the ramp up and ramp down test.			
Ramp range	Test frequency ramp:	Test Duration	Confirm no trip
49.0 Hz to 51.0 Hz	+0.95 Hzs^{-1}	2.1 s	no trip
51.0 Hz to 49.0 Hz	-0.95 Hzs^{-1}	2.1 s	no trip

11. Limited Frequency Sensitive Mode – Over frequency test: The test should be carried out using the specific threshold frequency of 50.4 Hz and **Droop** of 10%. This test should be carried out in accordance with Annex A.7.1.3, which also contains the measurement tolerances.	
Active Power response to rising frequency/time plots are attached if frequency injection tests are undertaken in accordance with Annex A.7.2.4.	**NA**
Alternatively, test results should be noted below:	

Test sequence at **Registered Capacity**>80%	Measured **Active Power** Output	Frequency	Primary Power Source	**Active Power** Gradient

[5]If the device requires additional shut down time (beyond 0.5 s but less than 1 s) then this should be stated on this form.

				Droop (%)
Step a) 50.00Hz ±0.01Hz	6005	50	6177	/
Step b) 50.45Hz ±0.05Hz	5944	50.45		9.84%
Step c) 50.70Hz ±0.10Hz	5617	50.7		9.28%
Step d) 51.15Hz ±0.05Hz	5031	51.15		9.24%
Step e) 50.70Hz ±0.10Hz	5618	50.7		9.30%
Step f) 50.45Hz ±0.05Hz	5944	50.45		9.84%
Step g) 50.00Hz ±0.01Hz	5999	50		/
Test sequence at **Registered Capacity** 40% - 60%	Measured Active Power Output	Frequency	Primary Power Source	Active Power Gradient Droop (%)
Step a) 50.00Hz ±0.01Hz	3002	50	3055	/
Step b) 50.45Hz ±0.05Hz	2943	50.45		10.17%
Step c) 50.70Hz ±0.10Hz	2615	50.7		9.30%
Step d) 51.15Hz ±0.05Hz	2025	51.15		9.21%
Step e) 50.70Hz ±0.10Hz	2616	50.7		9.33%
Step f) 50.45Hz ±0.05Hz	2944	50.45		10.34%
Step g) 50.00Hz ±0.01Hz	3000	50		/

12. Protection – Re-connection timer					
Test should prove that the reconnection sequence starts after a minimum delay of 20 s for restoration of voltage and frequency to within the stage 1 settings of Table 10.1. Both the time delay setting and the measured delay should be provided in this form; both should be greater than 20 s to pass. Confirmation should be provided that the **Power Generating Module** does not reconnect at the voltage and frequency settings below; a statement of "no reconnection" can be made.					
Time delay setting	Measured delay	Checks on no reconnection when voltage or frequency is brought to just outside stage 1 limits of Table 10.1.			
48s	48s	At 1.16 pu (266.2 V **LV** connection, 127.6 V **HV** connection assuming 110 V ph-ph VT)	At 0.78 pu (180.0 V **LV** connection, 85.8 V **HV** connection assuming 110 V ph-ph VT)	At 47.4 Hz	At 52.1 Hz
Confirmation that the **Power Generating Module** does not re-connect.		no re-connection	no re-connection	no re-connection	no re-connection

13. Fault level contribution: These tests shall be carried out in accordance with EREC G99 Annex A.7.1.5. Please complete each entry, even if the contribution to the fault level is zero.		
For **Inverter** output		
Time after fault	Volts	Amps
20ms	88	17.2
100ms	49.2	26.58
250ms	39.5	26.81
500ms	35.7	25.94
Time to trip	2.76	In seconds

14. Self-Monitoring solid state switching: No specified test requirements. Refer to Annex A.7.1.6.	
It has been verified that in the event of the solid state switching device failing to disconnect the **Power Park Module**, the voltage on the output side of the switching device is reduced to a value below 50 volts within 0.5 s.	Yes

15. Wiring functional tests: If required by para 15.2.1.	
Confirm that the relevant test schedule is attached (tests to be undertaken at time of commissioning)	NA

16. Logic interface (input port)	
Confirm that an input port is provided and can be used to shut down the module	Yes

Provide high level description of logic interface, e.g. details in 11.1.3.1 such as AC or DC signal (the additional comments box below can be used)	Yes
17. Cyber security	
Confirm that the **Power Generating Module** has been designed to comply with cyber security requirements, as detailed in 9.1.7.	Yes
Additional comments.	
The following documents are attached to this declaration: - "Clearline Inverters DNS declaration about Logic Interface", as for required in section 14; - "Clearline Inverters DNS declaration about Cyber-security", as for required in section 15;	